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SHOW WINDOW LIGHTING.

At the November meeting of the Chicago Section of the Illuminating Engineering Society of which a very brief report is given elsewhere in this issue, the question of show window lighting came in for an animated discussion. The principal point at issue was the relative merits of trough and cone reflectors for the lighting of such windows. A rather surprising difference of opinion was developed in the discussion, which seems to have been largely due to a lack of clearness in defintions, and also to the fact that some of the speakers had in mind one class of window while others were thinking of a radically different class. There is no doubt that there has been an immense amount of guess-work and ill-directed experiment in show window lighting, just as in nearly every other class of lighting in the past. The man with high and shallow show windows has adopted the same methods as his neighbor who has low deep windows without knowing the reason why. It is no very difficult matter to pick the best type of reflector for show window lighting when the shape of the window is given and the distribution of light obtained with the various reflectors available, is known. The most common type of trough reflector used in window lighting is ill-suited to the lighting of the majority of windows for the simple reason that the majority of windows are high and shallow. For a high shallow window from 3 to 5 ft. deep and 8 to 15 ft. high, conical reflectors which give a concentrated distribution of light are by all means the most efficient. It goes without saying that such conical reflectors should not be pointed straight down but should be placed at the front and top of the window and pointed at a slight angle away from the street.

When we come to a class of windows which are nearly as deep as they are high, the problem is entirely different and the wide distribution produced by the common form of trough window reflector is almost exactly what is wanted. The number of such deep windows is probably on the increase, but as yet they are confined mainly to the larger cities and to two classes of stores, namely, the largest and highest class mercantile establishments and the small stores with low ceilings at or slightly below street level. Even in cases where the ordinary forms of conical reflector would be too concentrating for windows which are nearly as deep as they are high, it is a question worth considering whether conical reflectors giving a wider distribution would not give more light on the goods where it is wanted than do trough reflectors in which the lamps are placed horizontally, for the reason that some light is wasted by the interference of lamp sockets and adjoining lamps in trough reflectors. Furthermore, some light is not directed at angles where it is needed. With conical reflectors a large proportion of the light can be thrown where it is needed on the goods. The experience of one of the largest stores in Chicago, as given by Mr. Pearson at the meeting referred to, which undoubtedly has splendidly lighted windows, gives practical confirmation to the theory that conical reflectors are the best for show window lighting. While the arrangement described by Mr. Pearson employs a trough, the trough is not of the ordinary form and in fact is of entirely secondary consideration, for inside of the trough turnip-shaped

reflector lamps are used which are virtually conical reflectors in themselves and give a distribution of light almost identical with that of a wide-angle conical reflector.

Modern Pole Lines.

Mr. Bowie's paper on strains in pole lines is exceedingly timely. For many years pole lines have been built on a certain canonical pattern worked out in the early days of the telegraph and only elaborated to a modern degree at a later period. Even the early power transmission lines followed closely telegraphic precedents, and only when long transmission became common so that the cost of the line rose to be a formidable part of the total investment did engineers awake to a real sense of the design of pole lines as an engineering problem. This was not altogether due to sheer negligence but in great measure to the timidity of those for whom engineers work. Even today the backer of a transmission project would generally prefer to copy an existing structure, however bad, which has succeeded in holding up its wires than to "take chances" with a structure, however scientifically designed, which is as yet untried. In short, the average man has a very exaggerated idea of the value of a low grade of experience. This we say as a preliminary defence of the very careful study of the design of a pole line as an engineering structure which Mr. Bowie has given us. Broadly, the stresses on a pole line are three kinds—dead weight, wind pressure and unbalanced wire pull, all of which may be in cold climates complicated by loads of sleet. The first named stress is in itself of small consequence since any line in the least able to resist the others will be amply strong as regards this. The wind pressure on the pole itself, greatest when the wind is straight across the line, is also generally not a serious matter unless the poles if wood are rotten at the bottom or if iron are insufficiently provided with foundations.

It is then with the last source of strain that Mr. Bowie particularly concerns himself. Practically the greatest stress to which a pole line is exposed is that developed when all the wires of a single span have given way, thus compelling the adjacent poles to play without warning or guys the role of terminal poles. The stress on the pole top resulting from this condition is readily found to a reasonably close approximation by following out Mr. Bowie's neat method of solution or some similar one. The very worst condition, of course, occurs when the line breaks from sleet load, in which case the initial strains from low temperature are high concurrently with extra load on the wires. The thing to which we would call particular attention in applying Mr. Bowie's equations is the need of considering the effect of the resulting stresses, first on the pins and cross-arms, and secondly on the stability of the supporting structure. Usually the pin and its fastening in the cross-arm is the weakest point of the system as regards unbalanced pull. A cross-arm will generally split under the twisting movement of the pin if iron, long before either pin or cross-arm will break; to construct a line for safety under extreme stress the maximum unbalanced pull must be supported not merely at the conventional point of application, but at the end of lever arms twelve to eighteen inches long acting in torsion on a wooden, or sometimes steel, member of relatively very meagre dimensions. Second, if a tower line with spans of 500 to 1,000 feet in length is considered, the maximum stress applied to the top must not endanger the stability of the structure due to its dead weight and moorings alone. In this case the force acts on a very long lever arm and is very suddenly applied, while the very cases in which from length of span the stress is greatest are those in which on account of sag the towers must be highest. We are disposed to think that the moorings of some tower lines have a lower factor of safety than should be generally encouraged. An interesting feature of Mr. Bowie's results is the difficulty encountered with aluminum in very long spans owing to the additional wind pressure element, which becomes more serious as the span grows longer. It would be interesting to know how far this would be counterbalanced by the reputed immunity from sleet of aluminum lines, which would be of considerable moment in cold climates. However, much can be done with moderate spans to which relatively large sag can be allowed. There is a steady tendency to increase spans even with wooden poles.

Wind Pressure.

We publish in another column a characteristically modest note from Dr. Finzi, touching his researches on wind pressure. An important item in it calls attention to an error in the article by Mr. Bowie published in our issue of September 20, in which a misplaced decimal point caused the application of data obtained by Finzi and Soldata to cylinders perhaps smaller than was justifiable. We do not think the slip seriously affected any of Mr. Bowie's conclusions, but as Dr. Finzi very properly notes, further data on wind pressure as applied to transmission lines are highly desirable. For this purpose the method suggested by Mr. Bowie appears to us the most practicable since it deals directly with a span of wire *in situ* and can readily be made self registering. The importance of this latter feature will be appreciated by every one who has had anything to do with measurements of quantities depending on the wind. For wind even when apparently blowing free is subject to very eccentric variations in direction and intensity. Within a few rods wind currents actually in opposite directions may be noted, and whirling eddies only a few yards or even feet in diameter are now and then observed. By putting up a test span and keeping a continuous record of both deflections and wind velocities, it would become possible to eliminate most of the accidental variations and to obtain a fairly exact equation between velocity and pressure. Of course, variations of wind direction would also be recorded, but if a span were erected across the prevailing wind direction one would be reasonably sure of getting sufficient data of normal pressure, and also on the effect of obliquity, which can hardly be taken for granted in the present condition of knowledge of the subject.

Incidentally the same apparatus could be fitted to record differences of tension at the support and variations of sag due to temperature, and a pretty complete knowledge of the behavior of suspended wires could be gained. There is great need for such information in these days. Nor is there yet anything like a proper collection of data concerning wind pressure upon larger surfaces than those involved in transmission wires. As regards large flat-faced bodies, there is a fair amount of information available, but what for instance is really known of pressure distribution on lattice girders and similar grid-like structures? One generally makes a rough estimate on the basis of the surface actually exposed; but is it correct? These matters are not purely of academic interest, as some excellent people are pleased to suppose. They are on the contrary of very vital importance in future engineering work in which factors of safety must be closely figured. The day is not far distant in which

steel cannot be reckoned with as the cheap and plentiful product of to-day. The supplies of iron ore are, to be sure, enormous, but they are not inexhaustible and the days of mining almost chemically pure magnetite with a steam shovel are rapidly drawing to a close. Within the careers of men now living iron will be enough scarcer than now to make a wide difference in the economics of its use. Structures will have to be figured with regard to close economy, and the habit of making standard girders and slapping them together in any way that will certainly be strong enough will have to be very materially modified. Hence data should be accumulated on wind stresses due to earth tremors and impressed vibrations and the like so as to be able to figure with due regard to economy. Work such as Dr. Finzi and his associate have been doing stands on an exceptionally high plane, for it is work for the future—for the ground work of the theories that shall push forward practice into realms as yet unknown. Of profound interest is Dr. Finzi's concluding note that under his own observation designs are now being made that give high promise of delivering to man the kingdoms of the air. No rule of thumb engineering suffices for such a task—then exact science comes into its own.

MEAN HORIZONTAL INTENSITY OF INCANDESCENT LAMPS.

In the early days of incandescent lighting it was soon observed that there was a distinct difference between the luminous intensity of an electric lamp in different horizontal directions. In those days the filaments were nearly all of the simple horseshoe, or vertical single-loop, type. The same character of variation of candlepower in different horizontal directions was then also well known with the flat fish-tail or bat's-wing gas burners in ordinary use. Whereas, however, it was then the commercial practice in gas-lighting and in electric arc-lighting to rate lamps by their maximum candlepower, electric incandescent lamps were rated by their mean horizontal candlepower. The incandescent lamp thus came into commercial use nominally at some eight per cent handicap or depreciation with respect to its rival, the ordinary gas burner. It is not clear why the incandescent lamp was more conscientious in its rating than arcs or flames. Possibly the steadiness of its light at steady terminal voltage made precision more desirable, and this precision, in turn, made aspirations more definite towards the scientific goal of mean spherical candlepower.

As soon as the custom became fixed of rating lamps by their mean horizontal candlepower, difficulties were encountered in defining and determining the calibration. At first an attempt was made to calibrate lamps by the arithmetical mean of two photometer readings, one with the plane of the filament loop in the photometer axis and the other with that plane perpendicular thereto. It was soon found, however, that life was too short and manufacture too swift to permit of this routine being maintained, so an attempt was made to compromise on the basis of a single photometer reading with the lamp's filament plane at 45 deg. to the photometer axis, or midway between the maximum and minimum candlepower positions. This plan served well for some time, until it came to be pointed out that the discrepancies involved were large in comparison with the observational error. It was not practicable to set the filament closely to a 45 deg. position, and even if this could be done with precision, the observed candlepower at that setting might be appreciably off the true mean horizontal candlepower. The precision of the photometer as a measuring instrument, together with the introduction of new types of filament, in which the 45 deg. setting could not be followed, compelled a resort to the rotation of the incandescent lamp at a speed of two or three revolutions per second about its vertical axis in the photometer test. With the ordinary types of incandescent-lamp filament, this rotation of the lamp enabled a close approximation to the mean horizontal candlepower to be estimated. There is usually a distinct flicker in the illumination of the photometer screen during the rotation, but many observers are not troubled by this, and some regard it as a positive advantage in assisting the judgment in effecting a photometer setting. This rotating lamp method is the one in general use at the present time.

An interesting article by Messrs. Edward P. Hyde and F. E. Cady, on page of this number gives the results of a valuable research on the effect of rotation upon the measurement of mean horizontal candlepower, first in regard to the bending of the filament, and second in regard to the flicker on the screen. It is shown that the effect of centrifugal forces, or "bending effect," is usually small in new lamps, up to a speed of six revolutions per second, except in the tantalum lamp, which, as we know, is in itself a host of exceptions. This agrees with general opinion on the subject; namely, that the bending effect is ordinarily negligible up to three revolutions per second, at least. In regard to the flicker effect, it is important to learn that there are lamps in general use with types of filament giving a relatively large difference of horizontal candlepower between maximum and minimum, seventy per cent being mentioned in one case. These must of course produce a pernicious flickering on the photometer screen at ordinary rotation speeds. It is important also to learn that the personal equation of the observer may throw his judgment either high or low in a definite direction, which varies from observer to observer. It does not seem to be stated at what speed of rotation flickers of such large amplitude disappear. It is, however, indicated that at a speed of six revolutions per second, or twelve flicker cycles per second, the effect on the photometer readings had by no means disappeared.

If we judge from the behavior with alternating currents of high-efficiency thin-filament incandescent lamps, which cease to flicker perceptibly at about thirty cycles per second, we might infer that the most viciously devious incandescent lamp should steady its flickering in the photometer at a speed of fifteen revolutions per second, or nine hundred per minute, which is a much higher speed than many filaments will safely permit of being employed. As pointed out in the article, since the speed of 360 revolutions per minute is insufficient to keep down the flicker-error with some types of filament, and this speed is perhaps the limit of safety, some change in the method of measurement should be adopted. It is proposed that a fixed mirror should be placed behind the rotating lamp in order to diminish the cyclic amplitude of flicker. This proposal seems to be an excellent one, although it is to be hoped that it will be needed with only a few special types of filaments; i. e., only when the range between maximum and minimum candlepower exceeds, say, 15 per cent of their arithmetical mean. The plan of supporting two such mirrors behind a stationary arc-lamp, in order to secure a better observation of its mean horizontal candlepower, has already been suggested and employed in arc-photometry by Blondel. The article contributes a distinct addition to the literature on the subject of cyclically varying illumination of a photometer screen.

The Telephone Ordinance in Chicago.

An important step in providing for the future of telephonic development in Chicago has been made in the ordinance drafted and submitted by the Chicago Telephone Company to the city council gas, oil and electric light committee, as a basis for a 20-year franchise. Broadly speaking, the ordinance provides for an extension of the present franchise to Jan. 8, 1929, the city to receive 3 per cent of the gross receipts for the exchange business done within the city, and at the expiration of the extension of franchise to have the option of buying out the company so that it may run on some M. O. plan. At all times the city is to have the right to examine the books of the company as freely as if the city of Chicago were a stockholder in the company.

The company is to furnish without charge to the city telephone sets for police and fire departments, and is to furnish regular telephone service to departments of the City Hall and to the school board at a reduction of 25 per cent from regular rates.

It is set forth that the ordinance shall not interfere with the right of the city to license telephone companies or to regulate rates, but it is stipulated that if the city takes such action the Chicago Telephone Company shall be absolved from its obligation to pay revenue to the city and to furnish the municipality with telephone facilities.

The ten party line residents service in the exchange is abolished, and changed from ten party to four party, the rate of 5 cents per day remaining the same.

The ten party business telephone, at a guaranteed rate of 10 cents per day, will be changed to two party lines, at a guaranteed rate of 10 cents a day with one message, or a guaranteed rate of 15 cents a day with three messages.

The four party residence rate at a guarantee of 10 cents a day will be reduced to 5 cents.

The two party guaranteed rate of 20 cents a day is reduced to 15 cents.

A new two party rate of 10 cents a day, with one message, is established.

The single line with a guarantee of 30 cents a day is reduced to 20 cents.

The guaranteed rate of 20 cents a day, with two calls, for single lines, is reduced to 15 cents. At least 97½ per cent of all telephones in the city will be reduced from present rates, according to officials of the company.

The rates on trunk lines in private exchanges are reduced from $36 to $24 per year, and the cost of messages from private exchanges, now 3 cents a call, is reduced to 2 cents, after the first 300 messages in each month.

Two rates providing for unlimited messages will continue for private residences. The present rate of $100 a year for single lines is reduced to $72.

The two party residence rate of $75 is reduced to $60 and the four party unlimited service is abolished and advanced without changing the price to the two party service at $5 a month.

Gasoline Lighting Permits Valueless.

Mr. Victor L. Scott, of the commercial department of the San Antonio Gas & Electric Company, has prepared a legal digest on gasoline lighting permits which has been published in the American Gas Institute proceedings of 1906. Mr. Scott's conclusions from the various decisions rendered seem to show that while gasoline lighting permits are issued regularly on insurance policies, such permits are so worded and so restrict the owner of the property that for all practical purposes they cancel the insurance policies both of the occupants and owners of the building. Court decisions are cited to show:

First, that any of the numerous restrictions contained in gasoline lighting permits when violated by the insured voids the policy.

Second, that the violation of any of these restrictions by the occupant of a building not only voids his policies on stock, but also voids the policies of the owner of the building regardless of the fact that the owner's policies have attached thereto gasoline lighting permits.

Third, that on a strict interpretation of the law it is almost impossible to handle this deadly explosive in such a manner as not to violate restrictions contained in any gasoline lighting permit. Mr. Scott cites numerous cases which bear out these conclusions.

Electricity in Old Houses.

A recent number of *The Illuminator*, published by the Cleveland Electric Illuminating Company, contains an illustrated article on "Electricity in Old Houses," the object of which is to show how easy it is to install wires in old houses. Pictures are given of the methods of running wires through joists by removing a floor board, and the appearance of outlets before and after the placing of the fixture. As has been previously explained in these columns, the Cleveland company is making a specially vigorous campaign to secure the wiring of old houses and has prepared an elaborate schedule of prices covering the wiring of old houses and providing for nearly every case which arises in practice. The solicitors take this schedule and secure contracts according to the figures given thereon. A customer may pay for the wiring in installments, one-fourth upon completion of the work and ten per cent of the balance per month. The schedule of prices and contract used in Cleveland is the result of months of very careful study, and was given in full in these columns in the issue of September 15, 1906, page 530.

Apprentices in Machine Factories.

An interesting report was presented by the apprenticeship committee of the National Machine Tool Builders' Association at the recent annual meeting in New York, by Mr. E. P. Bullard, Jr., the chairman. The data came from 76 representative concerns, including electrical manufacturers, engine builders and machine tool shops. As to the ratio of apprentices to machinists it was found that the percentages ranged in machine tool shops all the way from 2 per cent as a minimum to 33 per cent as a maximum, the average being about 18 per cent. In the allied trades the range was from 5 to 20 per cent and averaged about 13 per cent. Of the 29 manufacturers who employed apprentices under verbal agreement only 70 per cent were machine tool builders and 30 per cent engine and machine manufacturers. Of the 13 concerns who reported employing no apprentices at all 23 per cent were machine tool builders, while 77 per cent were of the allied trades. The International Association of Machinists limits the number of apprentices to 12½ per cent of machinists employed. Thirty-three per cent of the concerns offer special inducements to technical graduates but find it hard to secure them. The general results were in favor of the apprenticeship system.

The committee made some important suggestions as follows:

The drafting of uniform apprenticeship contracts covering both regular and special apprentices should be binding both to the employer and the employee, the former to be obliged to instruct the latter properly in the branch or branches of the trade specified in the contract, and it was suggested that the articles of indenture provide sufficient guarantee on the part of the apprentice for the satisfactory completion of his time of service, the wages paid to be optional with the individual employer. It is believed that this point is essential, as it is apparent from the investigation that apprentice wages vary in different sections of the country. It would seem advisable, however, to have a uniform term of service in all cases, to be based on the time found necessary by previous experience to properly teach the branch or branches of the trade specified in the contract.

The number of apprentices employed in any shop should be limited only by the ability of the employer to instruct them properly.

Graduate apprentices should be advanced wherever possible and preference given them in making promotions.

Special apprentices, or those indentured to one branch of the trade only, should have a common school education, and regular apprentices, or those indentured to the full trade, to have at least a grammar school education.

Courses of instruction for apprentices during their term of service should be provided where practicable, and attendance upon such courses, where provided, should be made compulsory. High school and technical graduates should be exempt from special study during their term of service. A special instructor should be provided where practicable.

Apprentices should be permitted to work on the premium or piece work systems. All small tools should be provided for their use free of charge, these to be furnished new on completion of their trial period, and presented to them on the satisfactory completion of their term of apprenticeship. These tools should be inspected by an authorized official at stated intervals and the condition reported. These reports would be valuable in determining the interest and ability of the apprentices.

Technical graduates should be encouraged to indenture themselves to the trade by offering higher wages and shorter period of service. Influence should be brought to bear upon those in authority at the technical schools to impress upon them the demand in the machine tool business for men having a technical education and willing to learn the practical side of the business.

Indenture apprentices to the various branches of the machinist trade, making the term of service short and wages relatively high. Offer bonus or reward for the satisfactory completion of apprenticeship.

Offer an opportunity for special apprentices to become regular apprentices, should they so desire on the completion of their special apprenticeship, the time so served applying on the regular apprenticeship course in proportion, as may be thought advisable.

Finally, issue a diploma bearing the seal of the National Machine Tool Builders' Association to both regular and special apprentices, stating clearly the work accomplished during term of service.

November Meeting of the New York Section of the Illuminating Engineering Society.

At the regular monthly meeting of the New York Section of the Illuminating Engineering Society, held on November 9, it was announced that the total membership to date numbers about 850. Arrangements are being made for securing quarters in the new United Engineering Building. The chairman stated his belief that the most effective work of the society would be the result of the co-operation of the gas and the electric men in order to reduce the cost of illumination to the consumer and at the same time to increase the income of the companies.

The general subject of the meeting was residence lighting, upon which three papers were presented. A paper by Mr. F. N. Olcott dealt with "Fixture Location in Residence Lighting"; Major E. L. Zalinski, U.S.A., read a paper on "Fixture Design and Location," while a paper by Mr. Preston S. Millar discussed the "Location of Lamps and Illuminating Efficiency."

In his paper on fixture location Mr. Olcott stated that the proper solution of the problem of locating the fixtures in residences is to employ lamps of low candle-power equally distributed and to provide sufficient switches so that the owner can use as much or as little light as the occasion may demand. The first and most important principle is to have the wiring properly installed with a full allowance of lamps for each outlet, and the outlets carefully located for effective illumination of the entire room. The proper allotment of lamps at the time of installation is consequently of the utmost importance.

Insufficient and misplaced outlets are met with very often and are one of the greatest hindrances to the fixture man in the execution of his part of the work, because at the present time the fixtures are the last thing considered. When the selection of fixtures is undertaken the house is practically completed, and to make any changes would mean the taking up of floors and often the cutting of walls, to which the owner will rarely agree. The members of the Illuminating Engineering Society can do much to overcome this condition, the main reason for which is the keeping down of the cost; in nine cases out of ten, if the necessity for more wiring and switches is properly explained to the owner, he will not hesitate at the expense. The owner uniformly blames the architect or electrician for any shortcomings in this line, and a little insistence at the right time will save them censure and give the owner the proper lighting and switching conveniences to which he is entitled, without the extra cost and annoyance in making changes.

Major Zalinski's paper dealt with the laws governing the intensity and distribution of light. There is some question as to the strict applicability of the law of inverse squares to the cases where reflectors are used, even with single incandescent lamps. But unless these reflectors are in whole or part of the parabolic type, securing a reflection approximately parallel to the axis, the law of inverse squares must still apply, approximately at least. In cases where the reflectors are partially parabolic, the law of inverse squares will apply to the angles outside of the axial angle, the rays of light being parallel at the latter. Generalizing, three cases may be assumed:

1. Reflectors parabolic throughout, where the law of inverse squares will not apply at all. 2. Reflectors partially parabolic, where the law will apply to the extraneous angles, but does not apply to the axial and immediately adjoining angles. 3. Ordinary conical and dome-shaped reflectors where the law of inverse squares practically applies throughout the field, but must be based on actual photometric measurements at different portions of the field. It is proper to assume that the reflectors used are not in part or wholly parabolic, and that, therefore, the law of inverse squares has application not alone in the height of placement of fixtures, but has also direct application in the matter of the most advantageous subdivision, lateral distribution and number.

The illumination demanded for ordinary good print reading is 1 foot-candle; for newspaper print 2 foot-candles; for the postal service 4 foot-candles, and for drafting 10 foot-candles. It is obviously desirable from consideration of economy and efficiency of illumination to place the lamps as low down and as near the plane to be illuminated as possible, the gain thus secured increasing very rapidly. Various other considerations, however, serve to limit and modify the extent of the lowering which is practically possible or desirable.

The paper by Mr. Millar considered the relative efficiencies of four different methods of indoor illumination, using as a basis precise measurements of the intensity of illumination produced by incandescent electric lamps used with various fixtures changeably placed. In a room 11 by 16 ft. by 12.5 ft. high, with light buff ceiling and walls and red floor, there were placed for test purposes a ceiling installation of twelve 16-cp lamps, a drop cord installation of six 16-cp lamps, a chandelier installation of four 16-cp lamps and a wall bracket installation of four 32-cp lamps. All of the above lamps were of the oval filament type, and were operated at the voltage at which they gave their rated candlepowers. They were used alone and also with reflectors and globes. A Weber photometer was employed to measure the illumination on a horizontal plane three feet above the floor.

One of the important features shown by the tests was the increased efficiency of illumination due to the use of reflectors in the drop cord installation, where a gain of 46 per cent in intensity of illumination was made. The reflectors used in the chandelier installation were not so effective, opal reflectors increasing the illumination 17 per cent and prismatic reflectors 25 per cent. The smaller increase in illumination observed was not chargeable to the nature of the reflectors, but was due rather to the fact that they were used upon the chandelier in the haphazard fashion common to such practice, where the use of reflectors is dictated by a desire to make the chandelier look complete rather than to improve the illumination.

The total flux of light from bare lamps used in each installation was analyzed to determine the total lumens which provided the direct lighting on the plane under consideration, and the total lumens which fell upon the ceiling and walls above the plane. This yielded the interesting information that only from 5 to 10 per cent of the total light emanating from the lamps went toward the direct illumination of the plane. In the case of the drop cord installation eight per cent of the light was effective in this manner, while 92 per cent was directed toward the ceiling and walls above the plane. After more or less multiple diffuse reflection the portion of the latter, which was not absorbed, finally assisted

in the illumination of the plane. This 92 per cent, if directed at the plane, would have increased its illumination by about 1,150 per cent. The portion of it which finally reached the plane increased the illumination by about 113 per cent. Each lumen which might have produced 0.09 lux produced 0.008 lux. Ninety per cent of the light which fell upon the ceiling and walls, or 83 per cent of the total light generation, was absorbed by the ceiling and walls.

The tests showed that the wall bracket installation secured a larger proportion of direct lighting than did the other installations, but it showed, on the other hand, that the light which was directed toward the ceiling and walls from the wall bracket installation was more largely absorbed before reaching the plane to be illuminated than the light which fell upon the ceiling and walls from the other installations. This was probably due to the fact that the general trend of the bulk of the reflected light from these lamps was along the walls horizontally, while with the ceiling and drop cord installations the general trend of such reflected light was downward toward the plane to be illuminated.

In discussing Mr. Millar's paper, Major Zalinski called attention to the exceptional value of the data recorded and expressed his sincere belief in the accuracy of the tests. The paper of Mr. Millar is one to which reference will frequently be made by illuminating engineers because it furnishes the first reliable information concerning the effect of the selection and location of lamps with reference to the illuminating efficiency.

Mr. J. H. Hallberg remarked that a consulting illuminating engineer is required to obtain results for the consumer, and not for the central stations. It is possible, however, by means of proper co-operation between the illuminating engineer, the architect and the central station, to obtain increased illumination without reducing the central station income. He noted that in one case the illumination had been increased by 100 per cent at an increased expense for equipment of only 20 per cent. Mr. E. Y. Porter expressed the opinion that it is equally as important to obtain effective illumination of the walls, ceilings and floor as it is to secure good distribution of light on a certain horizontal plane. It is not always best to throw the light downward. For drafting purposes the prime requisite is to have uniformity of distribution rather than a certain density of light, and seldom indeed do the conditions require an intensity of 10 candle-feet. Mr. G. B. Williams said that for use with parabolic reflectors it is important to employ a source of light approximating a point in dimension. Such condition cannot be obtained, but by the employment of a disc type of filament all practical requirements are sufficiently well met.

Dr. Clayton H. Sharp said that it is not necessary to use a point source of light in connection with parabolic reflectors. The results obtained with the ordinary filaments are quite satisfactory when the reflector is properly designed. In any event the inverse square law with reference to the change in the density of illumination with distance applies to a parabolic reflector only when the distance is extremely great. It is not possible to use the inverse square law for ordinary work in which the distance is too short.

Dr. W. S. Dennett explained that in the case of a perfect parabola, with a point light source located at the proper focus, the rays of light would be exactly parallel and that the intensity would not vary with the distance, so that the law of inverse squares could not be applied.

Mr. E. L. Elliott said that the results of the experiments which had been made with reflectors of the parabolic type used in connection with commercial forms of incandescent lamps had shown conclusively that even in ordinary illuminating work the law of inverse squares can be applied without involving an error of any practical importance.

A Failure at Kirkwood.

The city of Kirkwood, Mo., having found its venture in municipal ownership rather costly, will close down its municipal lighting plant and buy light and power from the local company for just one-third what it cost the city to manufacture it. Kirkwood built its lighting plant at a cost of $25,000 five years ago. The city still has $23,000 in bonds out against the plant which is to be closed down.

Meeting of the Chicago Section of the Illuminating Engineering Society.

The Chicago Section of the Illuminating Engineering Society held a meeting November 6, for which a new plan was tried that worked out very successfully. Members and guests took dinner together at 6 o'clock at Burton White's Café and proceeded to discussion immediately after dinner. The plan worked so well that it was decided to hold the December meeting in the same manner. The plan has the advantage that it makes possible an earlier adjournment than if the meeting were held in an auditorium at 8.30, gives more chance for informal talk and making acquaintances and frequently secures the attendance of many good men who would not come to an after-dinner meeting.

This was a "question box" meeting. No formal paper was presented, but after dinner the meeting was given over to the informal discussion of a number of practical questions. The interest displayed in each question brought it home to the membership that entire evenings could profitably be given to the discussion of any one of the questions proposed, and it seems likely that this plant of discussion rather than formal papers will be largely followed in the Chicago Section meetings for the balance of the year because of the practical value of the discussions which are thus brought out.

The first question discussed was, "To what extent in practice can the distribution of light about a lamp be modified by shades or otherwise to throw the light in certain directions?" As an extreme case of modification of the natural distribution of light about a 16-cp. lamp, Mr. J. R. Cravath cited the conical mirror reflector consisting of a tin case lined with plate mirrors, the angle of opening being 90 degrees. Such a reflector, according to a test made by the Electrical Testing Laboratories, with a 5-ft. photometer bar, gave 202 candle-power below the tip of the lamp, 136 candle-power 15 degrees away and 42 candle-power 30 degrees away from the vertical. The light was something in the nature of a searchlight beam. The law of inverse squares did not hold with such concentrated beams of light. With different lengths of photometer bar, different results would be obtained in testing all concentrating reflectors.

The second question discussed was, "To what extent can the rule for keeping lights out of the range of vision be followed in halls, churches, theaters, etc?" Discussion of this was opened by Mr. Albert Scheible. Mr. Scheible started with the assumption that bright lights, in order to be harmless to the eye of a person seated in the audience, should be at an angle of 65 degrees above the horizontal in order that the eyebrow may shade the eye. He then showed that in a great many churches, theaters and public halls, such an angle would necessitate preposterous and impracticable height of lamps, and from this drew the natural conclusion that in order to keep the sources of light where they will do no harm, they must either be concealed behind beams or cornices or placed in fixtures of special design which will screen the light from the eyes. He thought that an entire evening later in the season might with profit be given to discussion of fixtures and methods of screening the light in audience rooms. Mr. Scheible's remarks were followed by a long discussion, most of which centered about indirect lighting. It was pointed out that the concealing of lights in coves behind cornices and the reflection of light upward from these coves to a white ceiling gave a wonderfully well diffused illumination, but one which was too expensive for ordinary purposes. Mr. J. S. Reesman cited the case of a residence owner who had his library beautifully illuminated by thirty concealed cove lights. As a matter of fact, the man only used his cove lights on special occasions. For ordinary purposes he got along with one or two lamps in a portable table lamp, as he figured that he could hardly afford to run thirty lamps to read by when two would answer the purpose. Mr. Hermann von Holst, as an architect, pointed out the fact that in a certain class of church architecture a brilliant illumination over the whole church is not sought for by the architect. He wants rather a contrast of light and dark places to produce the effect of the candle-lighted churches of the Middle Ages. Mr. Cravath believed it entirely possible to produce the effect spoken of by Mr. Von Holst and at the same time get a good foot-candle intensity on the pews. We must remem-

ber that no church congregation will be satisfied with artistic effect unless there is sufficient light to make it easy to read in all parts of the church. He knew of cases where the mediæval lighting effect was secured by the architect so well that the congregation could not see to read and there was dissatisfaction as a result. Good illuminating efficiency could usually be obtained without sacrificing architectural effect if the design of the lighting was right.

In answer to the question, "To what extent can electric lamps that give off fumes be used for interior lighting and for what purpose is the new flaming arc lamp best adapted?" Mr. Homer E. Niesz thought the lighting of immense areas like coliseums and train sheds could be well accomplished by such lamps hung high, together with other illuminants hung lower for special purposes in places where more than the general illumination was wanted.

A very animated discussion took place on the question, "Are trough or cone reflectors the most efficient for lighting the majority of show windows and to what extent are high candlepower units such as arc lamps, Nernst lamps and chandeliers applicable in show window lighting?" Mr. Johnson, Mr. Schayer, Mr. Learned and Mr. Bird answered the first part of the question in favor of trough reflectors. The consensus of opinion also seemed to be against arc lamps or large Nernst lamps for window lighting on account of shadows and uneven distribution of the light. Mr. Cravath, while endorsing the statements of the others as to the superiority of the ordinary shape of trough reflector for the lighting of very low and very deep windows, thought that nevertheless for the majority of windows which were at the present time high and shallow the trough reflector in its usual shape wasted too much light at the top of the window and did not throw enough down. A more concentrating distribution such as given by cone reflectors was therefore desirable for the majority of windows, which are high and shallow. He gave specific figures on one case where a window was 5 ft. deep with the reflectors located 10 ft. high and showed that except in the extreme upper portion of the window the illumination was very much better with a 90 degree conical reflector made up of mirror plates than with the most common shape of trough reflector made up of mirror plates. For a window of this shape a better form of conical reflector could be lected. Mr. Curtis pointed out that there was probably less loss of light by the interference of the lamp bases in a cone reflector than in a trough reflector. Mr. Pearson described the arrangement he uses in one of the largest Chicago department stores, which he said had been the result of long experiment. This is a special form of trough, not of the ordinary shape inside of which are placed turnip-shaped reflector lamps. This was pointed at an angle which gave a good illumination from top to bottom of the window. Mr. George B. Johnson said that when the campaign was begun several years ago to get the small stores on North Clark Street to do window display lighting, they found the most effective arrangement to be mirrored conical reflectors placed at the front and top of the window, pointed toward the lower back corner of the window.

CURRENT NEWS AND NOTES.

PATERSON, N. J., has just cast a heavy vote in favor of installing a municipal lighting plant.

BOSTON OWNERSHIP.—The Board of Aldermen of Boston, Mass., has again voted down the proposal to establish a municipal electric lighting plant.

LIGHTING IN MONTREAL.—The Montreal Light, Heat & Power Company has been granted an exclusive franchise for supplying gas and electric lighting in Montreal for 30 years by a special committee representing the city council. The action must be sanctioned by the city council.

TELEPHONY IN CHICAGO.—The Chicago Telephone Company has offered reductions of 5 per cent net in various rates and compensation of 3 per cent of gross to the city in return for 20-year franchises. The offer to the city is almost identical with the terms now existing. The city will not accept it, report says, unless further concessions are granted.

IN AFGHANISTAN.—It is stated that the Ameer of Afghanistan has engaged an electrical engineer to install electrical machinery in the factories in the new town which he is building 30 miles north of Cabul. The arms and ammunition factories will probably be moved there, and other manufacturing industries started.

THEFT OF CURRENT.—It is stated that the Houston (Tex.) Lighting & Power Company is suffering so much loss from the theft of electrical energy that it is preparing to ask the city commissioner to enact a measure that will give it some protection, the measure to be framed so as to put a stop to the depredations. The trouble is becoming so notorious that the company is forced to the step it is preparing to take.

WISCONSIN LIGHTING COMMISSION.—Prof. A. S. Mitchell, city gas inspector, of Milwaukee, Wis., is making arrangements to have a conference with the Milwaukee members of the Legislature to introduce a law providing for a State lighting commission. It is proposed to give the commission power to fix the standard of gas to be furnished and a fair price for gas and electricity. Prof. Mitchell has been investigating the prices of gas and electricity in other cities and is in favor of a State commission.

INTERSTATE COMMERCE RULINGS.—It would seem likely that in the near future the Interstate Commerce Commission will have a good deal to say about interstate trolleys. The Illinois Central Railroad has made joint tariffs with the Chicago & Milwaukee electric line contrary to the trunk line agreement of two years ago not to interchange business on through rates with any electric line. The Chicago & Milwaukee Electric has brought the matter formally before the Interstate Commerce Commission by advice of Commissioner Knapp. Other railroads will probably follow the Illinois Central, but the commission may make a ruling requiring it.

TELEPHONY IN ITALY.—The telephone system of Italy is to be overhauled and improved by the government. It needs renovation badly. The Ministry of Posts and Telegraphs appointed recently a commission to investigate the telephone service throughout Italy, with the result that in many cities a complete change has been found to be necessary. In Rome the service was found to be extremely bad, and that city will probably be one of the first where a change will be made. The appointment of this commission was the first step of the ministry to take control of the telephone service of the entire country. Milan is the only city with a real modern system and has a fine common battery lamp signal exchange.

EXTENSIVE INTERURBAN TROLLEYS.—What will be, when completed, one of the largest interurban electric railways in this country, the Rochester, Syracuse & Eastern Railway, connecting the cities of Rochester and Syracuse, N. Y., has now opened up thirty-seven miles of the entire length of 83 miles from Rochester to Lyons. The undertaking, which is controlled mainly by Syracuse capitalists, of which Lyman C. Smith is president, has been conducted in the most up-to-date manner. It is expected that it will cost $6,000,000 to complete the road. The roadbed, which in many instances traverses private right of way, is of the most substantial construction, all the material used being the best obtainable. The power house equipment includes steam turbo-generators. The cars are solidly built, weighing approximately fifty tons and measuring 54 ft in length by 8½ ft. in width. Each car is equipped with four 125-hp motors, multiple-unit control and air brakes. All the plant is of Westinghouse manufacture. The company will operate express trains and accommodation trains, the former running at a regular schedule speed of from 50 to 60 miles an hour. On a recent trial trip a few days ago one of the cars attained a speed of 70 miles an hour.

COLUMBIA ENGINEERING SOCIETY.—Mr. Arthur Williams, president of the National Electric Light Association, will read a paper on the municipal ownership of lighting and power plants before the Electrical Engineering Society of Columbia University, New York City, on November 21, at 8.15 p.m., in room 301, Engineering Building. All interested in the subject are invited to attend.

NORTHWESTERN ELECTRICAL ASSOCIATION.—The Northwestern Electrical Association has decided to hold its next annual meeting at the Coliseum Building, Chicago, January 16, 17 and 18, in the belief that it will be an advantageous thing to do both for the members and for the management of the Electrical Show going on at that time. An excellent programme of papers is also being provided for the meeting.

WINNIPEG POWER PLANT.—The board of consulting engineers to be associated with Mr. C. B. Smith in the construction of the city of Winnipeg's power plant at Point du Bois Falls has been selected definitely. It will be composed of Prof. Louis Herdt, of McGill University, Montreal, Que.; H. N. Ruttan, city engineer, Winnipeg, and William Kennedy, Jr., of Montreal, Que. Prof. Herdt is recommended as electrical engineer, Col. Ruttan as hydraulic engineer and Mr. Kennedy as mechanical engineer.

INSTITUTE MONTHLY MEETING.—The 211th regular meeting of the American Institute of Electrical Engineers will be held in the Assembly Room of the New York Edison Company, 44 West 27th Street, on Friday, Nov. 23, 1906, at 8.15 p. m. The following papers will be presented and discussed: "New Types of Incandescent Lamps," by Clayton H. Sharp, Test Officer of the New York Testing Laboratories. "The Transformation of Electrical Power into Light," by Charles P. Steinmetz, Electrician of the General Electric Company, Schenectady, New York. The papers will be discussed by Messrs. J. W. Lieb, Jr., vice-president New York Edison Company; W. C. L. Eglin, electrical engineer of the Philadelphia Electrical Company, and P. H. Thomas, chief electrician of the Cooper-Hewitt Electric Company.

ELECTRICITY IN INDIA.—United States Consul-General William H. Michael writes from Calcutta as follows: It seems to me that it would pay American builders of electrical roads and of electrical cars and appliances to send representatives to the State of Mysore, which may be reached conveniently via Madras, Calcutta and Bombay, or by crossing from Ceylon to Tutocorin, and thence from each point by rail. There are good hotels in Bangalore and Mysore, both large cities, for the accommodation of the public. These cities are situated at an elevation above the sea that makes them delightful places to stay the year round. The Mysore Government has recently passed a tramway (electrical road) regulation which extends to the whole State of Mysore, although primarily conceived to meet the convenience of the Mysore Manganese Company. A project is on foot to build an electric line connecting the civil and military station with the old Bangalore City line and other extensions from that point. The whole system can be furnished with electricity from the Cauvery Falls, a head of water quite sufficient for not only the tramways but for lighting purposes and mills and factories. It is to be hoped that American electrical engineers and manufacturers of electrical goods will investigate the opportunities presented in Mysore State.

CORRESPONDENCE SCHOOLS.—Interesting data as to popular education were presented recently by the International Correspondence Schools, Scranton, Pa., on the occasion of the fifteenth anniversary. The history of the movement was reviewed in an address by the president, Thomas J. Foster. The total enrollment in the schools has reached about 930,000. Up to the latter part of last year 90,000 pupils had either received diplomas or completed advance study in the courses for which they were enrolled. In addition 250,000 pupils had completed elementary work in mathematics, drawing or other preliminary studies. In 1905 the total number of recitations or other student work sent into the schools and corrected by instructors was 732,069; the number of special instruction letters written was 109,680. The operating force in all departments is 2,800 and the buildings at Scranton represent an investment of over $500,000. A summary of the financial operations of the schools was given by President Foster and is as follows: "The first year, the receipts of the schools were $14,991; the second year, $35,939; the third year, $73,844. Last year they were $4,200,000. Last month they were $425,000, which is more than in any previous month. We receive $40,000 per year from New Zealand; $30,000 per year from South Africa; the Canadian agencies send us $180,000 per year. The whole amount received in the 15 years that the business has been conducted is $28,775,000. There has been paid $2,300,000 in dividends to the stockholders."

THE COLUMBUS FIZZLE.—A special dispatch from Columbus, Ohio, of November 11, says: "The City of Columbus, through the City Council, has decided to issue and sell, if possible, bonds to the amount of $140,000 to repair and equip the electric light plant owned by the city. It was thought the city would sell the plant to a private corporation, but political influences were too strong. Some of the members of the City Council wanted to employ an expert engineer to examine the large storage dam near the city, which cost a million dollars, and report whether the water power could not be used for generating electricity. This proposition was too sensible for the politicians. They seemed to want to generate the electricity at a greater cost. The plant has been a losing proposition. The debt of Columbus is $11,650,700. The taxable property is $80,000,000, and, according to the Longworth law, the city is within one million of the limit for bond issues. It has recently spent one million dollars for a filtration plant for the water supply, a million for a sewage disposal plant and a half million for a garbage disposal plant. The tax rate is now $3.03 on the $100. Adding to this the street paving and other extras, there are exorbitant tax bills. A cry has gone out by the advocates of the municipal ownership of the electric light plant that the generators are not sufficient to produce 2,040 lights as required and that the machines are overtaxed. Not long since the plant was shut down for repairs, and the light was furnished by private electric companies, and was so much better than that furnished by the city that some of the citizens wanted to continue the contract."

FEATHER RIVER POWER.—The Western Power Company, of California, which has invested heavily in Reno (Nev.) power and water propositions, is now engaged in the development of a very large hydro-electric power plant on the Feather River, near Oroville, Cal. The agents of the company have acquired a vast acreage of land and it is reported that within the next three years they will invest $5,500,000 in that locality. The west branch of the Feather River, along which the Western Pacific Railroad is forcing its way, makes a big bend in the Sierra about 25 miles from Oroville. This is known as Big Bend, and after winding through mile after mile of canyon and ravine the river comes back to a point within about three miles of where the bend starts. It is proposed to tunnel the mountain and divert the river from its course, bringing the water through the tunnel and utilizing the drop for the manufacture of power. A portion of this tunnel was constructed some years back, when a mining concern proposed to thus divert the water and mine the old bed for the deposits of gold that it was thought it would contain. A tunnel of two and a half miles was completed and the work stopped, as the funds of the company gave out. The Western Power Company will complete this work constructing about 3,800 ft. of additional tunnel. The corporation is a consolidation of power companies, which consolidation was recently effected in New York. It is capitalized at $25,000,000 and has the following officers: President, Edwin Hawley; vice-presidents, Frank H. Ray and Philip Stockton; secretary, H. P. Wilson; treasurer, Frank Tomkins. Of the $25,000,000 bonds authorized $8,000,000 has already been placed to pay for the construction work of the first plant. About 250 men are now employed at the plant under the direction of M. A. Viele, of the firm of Viele, Casper & Blackwell, New York consulting engineers.

ELECTRICAL BUSINESS GETTING.—The Co-operative Electrical Development Association has published in neat pamphlet form the paper by Mr. J. M. Robb, on the organization and conduct of a new business department suitable for central stations in cities of 50,000 population or less. This was awarded third prize in the competition held under the auspices of the National Electric Light Association.

ALUMINUM.—The United States Geological Survey places the consumption of aluminum in the United States in 1905 at 11,347,000 lb. Ten years ago it was only 920,000 lb. The valuation of aluminum and manufactures of aluminum of domestic production in 1905 is set at $290,777. The report says: "The production of aluminum in the United States has increased nearly ten-fold in as many years. Two reasons would explain this phenomenal growth—economic production, which has initiated lower prices, and increased consumption, especially in the electrical industry."

POWER IN UTAH.—It is definitely announced by W. H. Bancroft, vice-president and general manager of the Oregon Short Line, that Mr. E. H. Harriman and his associates have purchased three-fifths of the stock of the Utah Light & Railway Company, giving them control of the principal public utilities in Salt Lake City. The Twin Falls Power Company passes into the hands of the Harriman interests and now the combination controls water power plants installed and projected which will generate 200,000 hp. As rapidly as possible transmission lines will be built from the power plants on the Snake River in Idaho to Salt Lake. In fact, the work will be rushed, so that, when on January 1 the Salt Lake traction system changes hands, there will be power in plenty to spare.

MARCONI'S NEW WORK.—A cable dispatch from Pisa, Italy, of November 9, says: "King Victor Emmanuel and Queen Helena, accompanied by William Marconi, have gone to Coltano, near here, to inspect the new station for wireless telegraphic communication with Argentina. This station is exceptionally powerful, having one 600-hp dynamo for the purpose of communicating with South American, and another, less powerful, for communication with Mediterranean points. In the course of an interview to-day Mr. Marconi explained that he had been obliged to employ especially trustworthy workmen and clerks at the Coltano station in order to prevent the divulgence of important improvements introduced at this station.

THE AWAKENING A TRAGEDY.—Mr. Dexter Marshall, in a long article to the New York *Evening Post,* tells the long tale of frightful taxes and continual disaster in connection with the municipal plants of London. He says: "It took the people of London a long time to realize that the increase in taxation was due to the fact that the municipal trading operations, begun so extensively and so blithely in the nineties, were costing a good deal more than was expected; that, somehow, the expenditures were much in excess of the returns, in spite of rose-colored 'statements' and balance sheets and optimistic predictions, and that they, the people of London, were making good the deficit out of their own pockets. By the beginning of the present year, however, they had become fairly enlightened. Even the workingmen, many of whom, under the compounding system, pay their 'rates' in their rents, had been roused by that time. They had found out at last that the average increase of at least 25 per cent in rents was not due to the greediness of the 'grasping' landlord, but to the extravagant operation of the various municipal enterprises. To them the awakening was a tragedy." Hence, the tremendous overthrow of the "municipalites" at the recent election.

DISTRIBUTING MUSIC.—The new electrical industry of distributing music electrically by means of the Cahill telharmonium and the telephone may be said to have come down to a definite basis last week when the first central plant, that in New York, went into commercial operation. It will be remembered that at the end of September the station was put in operation for the opening session of the New York Electrical Society, when a demonstration was given. This was followed up by a series of tests as to distribution of the music over circuits between the plant uptown and points at the southern end of the city, with good general results. Meantime an inquiry for the service developed and last week the music was delivered to one of the best-known of the restaurants along the "Great White Way," the proprietor having been very urgent in his request for it. A little later in the week the service was connected into Martin's famous cafe at Madison Square, about a mile from the central station. It would seem that in a very few months the service will be quite general. An interesting technical development last week was the delivery of the music through a "singing arc." It was found that the lamp acted as an admirable receiver for the musical alternating currents, and that it is likely to prove one of the attractive features of the regular daily entertainment that is now being organized to be given in the large telharmonium headquarters on upper Broadway, opposite the Metropolitan Opera House. In short, the telharmonium bids fair to become one of the distinctive "sensations" of the New York winter season.

ELECTRIC LIGHTING OFFICES.—Our London contemporary, *Electrical Industries,* in a discussion of recent topics and matter in these pages, remarks: "No American business man could sleep o' nights if he thought he was not taking full advantage of the advertising opportunities ready to his hand. He would use these office sites to blazon forth the virtues of electricity in a way which would make the passers-by stop and marvel. He would utterly fail to understand the view of business which is content with the simple inscription of the name of the company on the office front in a crowded main street. He could not appreciate the motives which induce a company to communicate with its existing customers only through the medium of quarterly bills, and to seek new business in a diffident and almost deprecatory fashion. To put it shortly, the American has no appreciation of commercial modesty. The practical question, however, is whether it is advisable for the London companies to cultivate their modesty to the extremes indicated. It is only within the last year or two that the necessity for active publicity has been evident; during earlier years business came more or less by itself. Directors and managers admit that it is now necessary to advertise, and to advertise boldly; but they are divided to some extent on the question of ways and means. In discussing more elaborate methods they may have overlooked a simple and cheap method near at hand. At any rate we feel inclined to follow to the extent of suggesting that a certain amount of brightness in the offices and power stations would be both useful and attractive."

DENATURED ALCOHOL.—The committee of manufacturers formed to assist in securing cheaper alcohol for industrial purposes has issued in pamphlet form the regulations prescribed by the Commissioner of Internal Revenue under the untaxed denaturized alcohol law, which goes into effect on January 1, 1907. These regulations are intended to permit the freest possible use of industrial alcohol, and will, it is believed, be found generally satisfactory to the interests on whose behalf Congress removed the tax from alcohol made unfit for beverage purposes. The requirements of the regulations in regard to the production, sale and use of denaturized alcohol can easily be complied with, and will make it possible for consumers of this material to secure it at a very moderate price. Provision has only been made for a mixture of grain alcohol with 10 per cent of wood alcohol and ½ of 1 per cent of benzine. The question of authorizing the use of other denaturizing substances, for industries which cannot use a mixture of grain and wood alcohol, will be taken up in the near future by the Internal Revenue Bureau, which will consider suggestions submitted by manufacturers and prescribe regulations providing for the use of special denaturizing agents. In the meantime the French Government has instituted two prizes: one of 20,000 francs ($3,860) for the person who shall discover an agent for denaturing alcohol more advantageous than the denaturing agent actually known, and offering to the treasury every guaranty against fraud; another of 50,000 francs ($9,650) for the person who shall discover a system permitting of the utilization of alcohol for illumination, under the same conditions as petroleum.

DR. S. S. WHEELER, past-president of the American Institute of Electrical Engineers, 1905-6, has been nominated as first vice-president of the Automobile Club of America. The election takes place November 19.

MILAN AWARDS.—The New York Edison Company has been awarded a gold medal at the Milan International Exposition for its exhibit of central station work, street illumination, welfare work and bound volumes of its well-known *Bulletin.*

ELECTRICITY IN NEW YORK.—The New York Edison Company contracted with 2,757 customers in September, requiring 226,941 16-cp equivalents. The contracts included 5,232 hp in motors and 40 separate pieces of electric heating and cooking apparatus. Two electric clothes drying closets are to be put in service during November.

POWER FOR A FACTORY.—In the Electrical World of October 20 an interesting article of six pages was devoted to a description of the F. Wesel Manufacturing Company's plant in Brooklyn, N. Y., where nearly 200 electric motors are in use for various purposes of motor drive on machine tools. It was stated in the article that electrical energy for the factory is developed by an isolated plant comprising two steam-driven 100-kw direct-current generators. This plant is well designed and economically run, but the owners made last week a contract with the Edison Electric Illuminating Company of Brooklyn for the entire supply of electrical energy needed for their equipment, and the isolated plant will therefore be shut down. The average load carried by the generators is stated in our article to be 150 hp and the rating of the motors aggregates nearly 400 hp. There are 475 incandescent lamps of 16 cp in use, and eight enclosed arcs, and the lighting load is carried by a storage battery with a capacity of 40 amperes for eight hours.

ELECTROLYSIS AT ROUBAIX.—United States Consul C. Coleman writes from Roubaix, France, that the Department of Post Office Telegraphs is much perturbed at finding its telephone lead-covered cables fit for little but the scrap heap owing to electrolysis. Two long lines will have to be replaced. The cables appear to have been simply buried in the earth. "The new work will, of course, require great expenditure, and the question arises as to upon whom it will fall. The administration of posts and telegraphs will, no doubt, endeavor to impose it on the tramway company, declared by divers expert opinions to be the author of all the trouble. But the latter administration asserts anterior rights, in view of its installation having been made prior to that of the telephone cables, contending that the postal administration should, at the beginning, have adopted the precautions which they have deferred until now. In the end the difficult question of the respective shares of the cost to be borne by the one and the other administration will, no doubt, be determined by a process of law before the council of the prefecture at Lille."

ALUMINUM RECTIFIER.—In a patent granted November 6 to Mr. William S. Andrews on a form of aluminum rectifier, applicable to polyphase circuits, the following explanation of the action of this type of rectifier is given: The operation of the so-called "aluminum" rectifier is based on a peculiar property of aluminum when used as an electrode in certain electrolytes. If an aluminum plate is used as anode in a cell containing a solution of certain well-known salts, practically no current will flow through the cell, except during a very short interval of time after the pressure is applied. It is generally supposed that this resistance to the flow of current is caused by a thin layer of aluminum oxide formed on the aluminum plate by this small initial current. This film of oxide, while extremely thin, serves to prevent an appreciable flow of current from the plate to the electrolyte; but if the impressed pressure is reversed in direction, so that the aluminum plate becomes the cathode of the cell, the oxide immediately breaks down, due probably to the reducing action of the current, and the current flows freely through the cell. If an alternating current of low voltage is impressed on such a cell, the current will flow during each alternate half cycle, but will be almost wholly prevented from flowing during the other half cycle, so that the resultant current through the cell will be a pulsating unidirectional current flowing toward the aluminum. A device which thus allows current to pass freely in one direction, but substantially prevents the flow in the opposite direction, is commonly called an "asymmetric" conductor.

TURBINE WATER WHEEL TESTS.—A report of unusual interest to engineers and users of water power is a compilation of turbine water wheel tests and power tables that has just been issued by the United States Geological Survey as Water supply Paper No. 180. The results of tests of modern wheels by the Holyoke Power Company serve as a basis for the bulk of the data, but other tests and manufacturers' tables have been utilized whenever available. One object of the paper has been to furnish information required in measuring the flow of streams where the turbine is used as a water meter. The paper contains rating tables and the results of tests of different makes of turbines with register, pivot or cylinder gates, so that the power developed at the mills and the quantity of water used can be determined from the size and type of the wheels. As the water rights of mills can often be definitely ascertained only from quantity of water used, and as some of the wheels are no longer built or catalogued, the records of tests of the older types will be of great value to engineers who may be required to determine questions of water rights. The paper contains also a clear presentation of the evolution of the different types of turbines, all available data relative to the efficiency of the wheels and the power developed, a description of the best methods of turbine setting and arrangement and a discussion of the conditions that govern the economy in size and number of turbines used. This paper, which may be obtained on application to the director of the United States Geological Survey, Washington, D. C., is probably the only published compilation of such data. Many wheels have been tested, but as a rule such work has been done for private parties and the results have not been available to the engineering public.

LONDON'S ELECTRIC TRAMWAYS.—In an article in the *North American Review* Mr. E. E. Williams says with regard to the trolley system of London: "As to the County Council's trading enterprises, the most important at present is the tramway service. Until the London County Council got to work tramways were in the hands of private companies. But in these charters, or acts of Parliament, power to purchase the undertakings was given to the local authority, and the County Council lost no time in setting about the purchase. The purchases have had to be made in pieces, in different years; about 98 miles of tramways had been bought up to March, 1905, and further purchases were in contemplation. The purchase money amounted to over two millions, sterling, but another million may be added for other expenditure incurred in connection with the tramways. The Council is now building or projecting tramways in every direction throughout its area. The County Council does not allow adequate sums, in its annual accounts, for depreciation of plant. The depreciation is about £35,000 a year upon lines capitalized at £2,670,000—equivalent to less than 1½ per cent, which is an absurdly inadequate allowance. Having the security of London at its back, the Council has been able to borrow money for tramways at rates which private undertakings can only regard, with envy, afar off—something under, or about, 3 per cent. Even so, the profits are tiny. For the year ended March, 1905, they amounted to £7,084, after allowing the above-mentioned sum for depreciation. The year before there was a deficit. The fact remains that the municipal ownership of London's tramways is a most expensive failure, partly the result of mismanagement, partly the arithmetical effect of reducing fares to a non-paying basis and raising wages and decreasing hours of labor, with the same disregard of the balance sheet. The mismanagement is the result of putting an industry under the control of men who know nothing about it; the low fares were a bribe to the democratic voters; the increased wages and reduced hours of work are sufficiently accounted for by the open cringing of the Council to the trade unions. The explanations are various; the main fact is simple; the municipal ownership of London's tramways is a costly failure."

Electric Mine Drainage in Europe.

AT the "St. Marie" mine of the Actiengesellschaft Moselhütte, in Maizieres, an electrically-operated mine drainage plant was recently installed by Sulzer Bros., of Ludwigshafen, on the Rhine, Germany, and Winterthur, Switzerland. This equipment was intended merely as an auxiliary to the original plant, but is said to have worked so successfully that it now does all of the drainage pumping.

This pumping plant is equipped with motors built at Berlin by the Allgemeine Elektricitäts-Gesellschaft, the current being supplied to the same at 5,000 volts pressure, the pumps running at a speed of 960 r.p.m. and delivering 245 cu. ft. of water per minute. The pumps, which are of the centrifugal type, work against a head of 490 ft., all delivering to a common pipe and drawing separately from a common sump. All of the starting devices, switchboard and other electrical equipment are installed in the pump and motor chamber. Fig. 2 shows the arrangement of the

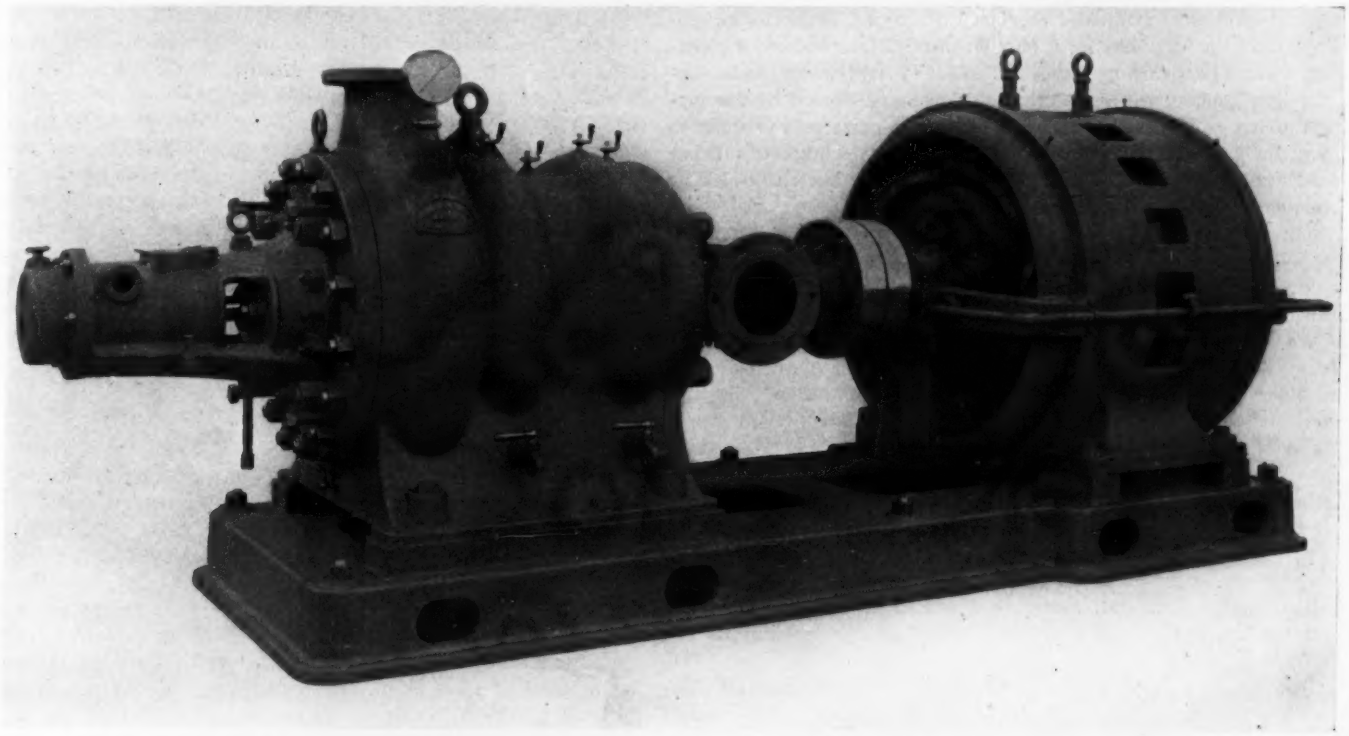

FIG. 1.—MOTOR-DRIVEN SIX-STAGE CENTRIFUGAL PUMP AT THE MERKUR SHAFT OF THE EMS MINES.

equipment, *S* being the switchboard, *A* the starter, *M* the motors, *H* the delivery gate valves and *R* the check valves.

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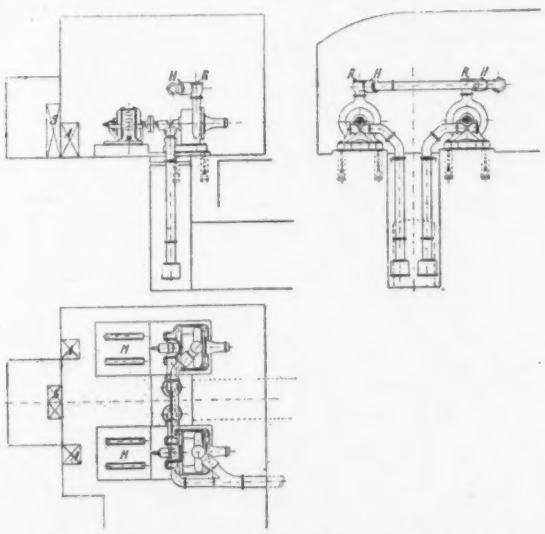


FIG. 2.—DRAINAGE PLANT AT ST. MARIE MINE.

mine, there are in operation two motor-driven centrifugal pumps of the high-lift, six-stage type delivering 105 cu. ft. of water per minutes to the great height of 2,150 ft. These pumps are connected in series, one pump drawing from the sump and delivering

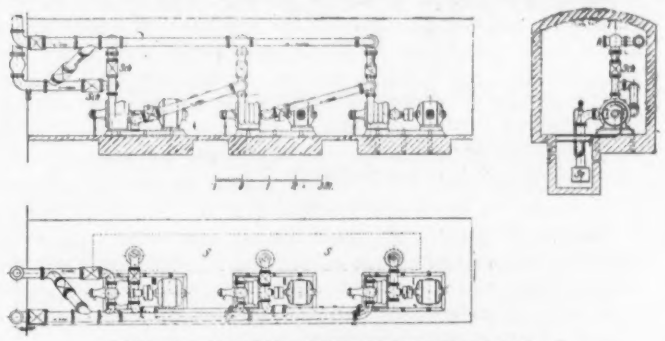


FIG. 3.—KASIMIR MINE DRAINAGE PLANT.

to the other, the speed of operation being 1,480 r.p.m.

As soon as one pump is started it fills the second pump and then that is started, the delivery nozzle of one pump being directly connected to the suction nozzle of the other, the latter being provided with a check valve, and each being driven by its own motor.

In some cases, as at Sierra Almagrera, in Spain, the pumps in series at the drainage plant are coupled to one motor, one pump being connected on either end of the rotor of the motor; this arrangement reduces the cost of the equipment, as well as the space required, and increases the efficiency as there are less losses in one large motor than in two small ones.

Another interesting electric drainage plant is that of the Kasimir mine at Niemne, near Granica (Fig. 3), owned and operated by the Warschauer Gesellschaft für Kohlenbergbau und Huttenbetrieb. The combination at this plant permits the pumps to be coupled in parallel for quantity or in series for high pressure as desired. Each of the three high-lift centrifugal pumps is capable of delivering 140 cu. ft. per second when operating at 975 r.p.m. against a head of 538 ft., but arrangements have been made so that each pump may draw water from the sump separately so that 420 cu. ft. of water may be delivered per second to the higher level. If it is desired to deliver directly to the surface, three times the pressure may be pumped against by setting the gate valves properly and forcing the water through the three pumps in series.

In reference to the efficiency of the horizontal high-lift centrifugal pumps, it may be said that tests were made at the mine plants at Horcajo, Spain, after five years' working and also after

one year's installation and operation and in each case the efficiency was found to be 76 per cent. The test after five years' operation was against a head of 1,600 ft. with an output of 500 hp and a speed of 870 r.p.m., and the test after one year's run was at the same speed, 420 hp being the average output, the water being raised 1,290 ft. The curves for this last test are shown in Fig. 4 where 1 is the efficiency, 2 the input and 3 the output.

It is stated that the efficiency of the Horcajo second installation was 79.5 per cent for the 235 hp pumps delivering 3.6 cu. ft. of water per second, the speed being constant at 1,320 revolutions per minute.

The Sulzer centrifugal pumps are provided with a guide wheel which surrounds the impeller, serving to direct the water discharged from the impeller, reducing its velocity and converting part of the latter into pressure, increasing in this manner the efficiency as well as the lift of the pump.

It will be noted that for working against a higher head several of these impellers are mounted on the same shaft in series, surrounded by their guide wheels. The high-lift centrifugal pump of the six-stage construction has a casing which consists of six annular pressure chambers, the last one having a nozzle for delivery and the first having a suction nozzle, fastened on the casing, a cap plate closing the other end. This plate or cover supports one bearing while the other bearing is supported by the suction nozzle. The six impellers are keyed in pairs on the shaft so that the side thrust is entirely eliminated, two impellers being surrounded by one double guide wheel, containing the overflow openings as well as the spiral shaped guide channels.

The Central Mining Power Station at the Silver mine at Horcajo, Spain, is equipped with six Sulzer cross-compound steam engines operating with steam at a pressure of eight atmospheres. Each engine has a capacity of 225 hp and drives its alternator at a speed of 115 r.p.m. The energy is transmitted at 1,000 volts from the central station to the mine drainage plant which is equipped with six alternating-current motors of the six-pole type constructed by Brown Boveri & Company, of Baden, Switzerland.

The pumps are located in underground chambers at various levels and deliver 2.88 cu. ft. of water per second, the total head being 1,600 ft. These centrifugal pumps are connected in series, the pump at the lowest level drawing the water and delivering it to the pump at the next highest level, and so on until the water is delivered at the surface. Each of these four pumps is provided with impellers one-half meter in diameter and raises the water 430 ft., the motor operating at a speed of 850 revolutions per minute.

The latest electric pumping installation at this mine also delivers the water a height of 430 ft. for each pump, but the speed of the motors and pumps is increased to 110 r.p.m. while the output is increased to 3.6 cu. ft. per second.

A unique and interesting drainage plant is that at the Victor

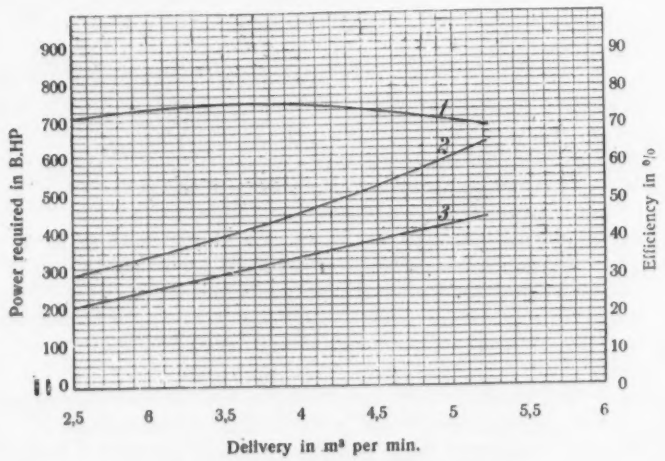


FIG. 4.—TEST OF SULZER PUMP.

mine in Rauxel, in Westphalia, where the entire head is pumped against by a single lift. At this mine there are two 570-hp motors, each driving a four-stage pump at a speed of 1,040 r.p.m. These two pumps are connected in series and deliver 4.2 cu. ft. of water per second directly against a total head of 1,700 ft. See Fig. 5.

The electrical energy is supplied from a central power station which is equipped with an alternator constructed at Berlin by the Allgemeine Elektrizitate Gesellschaft delivering current at 5,250 volts. The alternator is driven by a cross-compound engine at a speed of 110 r.p.m. The engine has a stroke of 1.1 meters, the low-pressure cylinder measuring 1.25 meters in diameter and the high-pressure cylinder 760 mm. The exciter for the fields of the alternator supplies a current of 245 amp. at 110 volts and is driven by a vertical compound engine at 280 r.p.m.

An electric central power station was installed at Lindenbach,

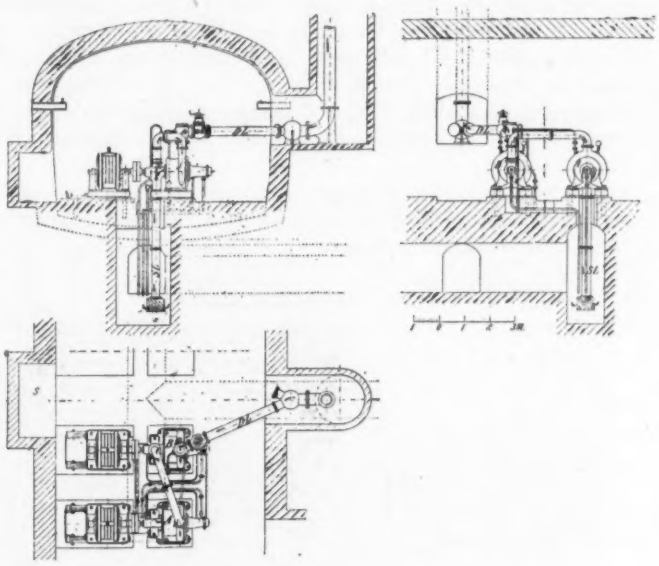


FIG. 5.—PUMP PLANT AT VICTOR MINE.

Germany, the power transmission plant supplying energy to various mine shafts for operating pumps, hoists and other mining machinery. The mine "Merkur" is two miles from the power station and the "Hohler Schacht," four miles distant, while there are a half dozen other mines supplied with energy from the same station. At the "Merkur" shaft of the Ems mines there were two Sulzer sinking pumps installed on hauling cables to drain the mine from the ninth to the sixteenth levels. Each pump operates at a speed of 1,455 r.p.m. and requires 206 hp, delivering against a head of 850 ft. water to the amount of 1.5 cu. ft. per second. Three horizontal centrifugal pumps are provided for on the sixteenth level and also on the ninth level, while the sinking pumps are to be used for sinking additional shafts.

In many modern mines motor-driven centrifugal pumps are employed for drainage purposes, sometimes operated by electric energy generated in central stations using gas engines, also steam turbines and oil engines. In some instances oil engines are utilized directly for driving high-power, high-service centrifugal pumps by means of belt transmission.

At the "Upper Silesia" shaft the energy for operating the electric sinking mine pumps is supplied from a power station four miles away from the shaft, the transmission pressure being 8,000 volts, transformers being utilized at the mine for reducing the pressure to 1,000 volts as a working potential. The power station is equipped with two 100-hp internal combustion engines supplied with furnace gas. They are directly connected to electrical generators which supply the necessary energy for operating the mining machinery.

The "Lindenbach" mining power plant for Ems mines is equipped with steam engines of the horizontal four-cylinder, triple-expansion type with Sulzer valve gear for driving the large alternators, while vertical single-cylinder, non-condensing engines drive the exciter machines. Each engine drives a Siemens-Schuckert 8,000-volt alternator supplying energy to the transmission lines to the mines, .54 mile, at Rosenberg; .6 mile to Bergmannstrost, and 1.4 mile to Fahnenberg and Bleihütte as well as 1.7 mile to Pfingstwiese. Each alternator has an output of 1,240 kw with an inductive load and 1,440 kw non-inductive load.

The current is supplied to the two electrically-operated sinking pumps and three electric pumping sets on the ninth level of the Merkur shaft. There are three of these pumps already installed with space for another of the same capacity, 1.5 cu. ft. per second against a head of 850 ft.

These high-lift centrifugal pumps are of the six-stage Sulzer type driven at a speed of 1,455 r.p.m. by 225-hp, 50-cycle Schuckert induction motors. (See Fig. 1.) The pumps working as above take about 206 hp.

The pumps draw the water directly from the water drift of the mine level by an ordinary suction pipe. It is stated that later it will be necessary to use a second suction pipe for feeding the water under pressure from the sixteenth level.

The high-lift centrifugal pumps have come lnto extensive use for mining service and the electrically-operated sinking type is particularly valuable, in certain instances doing work which no other design can successfully accomplish. It is stated that the first high-power, high-lift centrifugal sinking pump plant was installed by Sulzer Bros. at an Upper Silesia shaft to be sunk 1,330 ft. in depth. At this "Donnersmarkhütte" mine shaft very large springs were encountered at a depth of 330 ft., which caused great trouble, threatening the miners' lives and flooding the shaft and the mine, 9 cu. ft. per second being the rate of inflow of water. Steam pumps were of no use, as they required a large amount of space, leaving no room for a kibble, even with three steam pumps having a total capacity of 6 cu. ft. per second, and it was necessary to abandon the valuable shaft. Finally three sets of electrically-driven, high-lift centrifugal sinking pumps of the Sulzer type, shown in Fig. 6, were installed, each having an output of 4.8 cu. ft. per second and operating at a speed of 970 r.p.m. This gave a total of 14.4 cu. ft. per second against a head

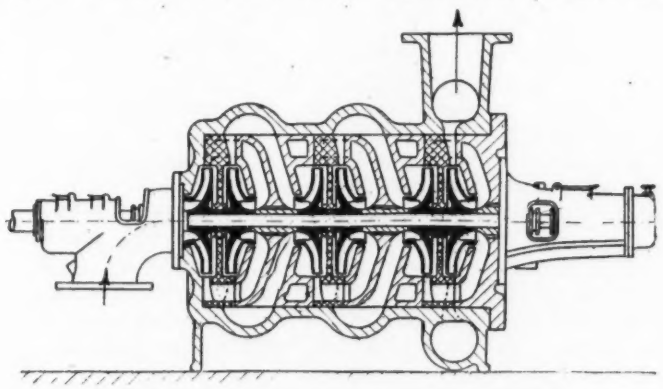


FIG. 6.—SULZER HIGH-LIFT CENTRIFUGAL PUMP.

of 530 ft., and space was left for two kibbles without crowding.

One of the great advantages of these electric sinking pumps is the small space required. At this plant the steel cable is 62 mm. in diameter, which suports not only the electric pump, but the filled delivery pipe weighing 114,500 lb., half of which is carried by each cable.

This installation worked admirably, the drainage of the shaft being accomplished in a short time, as one pump was found to be capable of delivering the full 9 cu. ft. per second at first on account of the low head, while later as the head increases the other pumps were started and brought into service. It is claimed that no trouble was encountered during sinking, blasting or springing, and that as soon as the drainage of the shaft was accomplished the pumps were employed as a stationary drainage plant, and they are now doing service in that capacity.

The efficiency of these pumps is said to be extremely high considering the usual low efficiency of centrifugal pumps. One of the Sulzer electrically-driven, high-lift centrifugal pumps built for a delivery of 16 cu. meters per minute to a manometric head of 45 meters and driven at a speed of 1,025 r.p.m. is said to have given an efficiency of 83 per cent at the guaranteed output; under different conditions of working is said to have increased the efficiency to 84 per cent, thereby showing the high efficiency that can be attained when great amounts of water are to be raised.

The efficiency curves of these pumps show that at favorable proportion between delivery and lift an efficiency of 80 per cent is easily obtained with this type of high-lift centrifugal pump, largely through the proper design of the impellers and guide wheels.

Strains in Pole Lines.

BY AUG. J. BOWIE, JR.

THE construction of electric pole lines is usually undertaken without any calculations whatever of the stresses liable to come on the poles—the only criterion being that the poles must stand up under the weather, and consequently the factor of safety used may be many times in excess of the needs of the case. Of course, in many cases, allowance must be made for the addition of wire, not planned for, when the lines are first constructed, and also, particularly in the case of wooden poles, the factor of safety used should be sufficiently large to allow for the partial destruction of the pole, before necessitating renewals. Still there are many places, as for example in long-distance, high-tension pole lines, where the conditions of the case may be regarded as fixed, the number of wires being limited. Furthermore, where towers are used, instead of wooden poles, we are not limited by stock sizes of timber, but may construct the towers, by proper design, so that they are of a uniform strength, and hence employ a minimum quantity of steel for given results, provided we know the stresses to which they will be subjected.

The stresses in poles and towers are in general due to the following three causes:

1. Dead weight.
2. Wind pressure.
3. Stresses due to the breakage of one or more of the line wires.

The most severe strains will usually occur when the wind is normal to the pole line, and hence when these three stresses act in three directions, practically at right angles to each other.

1. *Dead Weight.*—This consists of the dead weight of the poles, to which must be added the weight of one span of wires together with any snow or ice coating. This acts vertically downwards.

2. *Wind Pressure.*—This will usually be greatest when normal to the line, when the pressure is due to the area of the pole, plus the area of one span of the wires and their covering of ice, if coated thereby. The wind pressure may be expressed as the product of the area normal to the plane of the wind, the velocity head pressure and a coefficient, C, dependent on the shape and size of the surface acted on. The velocity head pressure is the pressure per unit of area, required to give the air its velocity, and is directly proportional to the square of the velocity, and directly proportional to the density of the air. At the normal barometer at sea level, of 29.92 in. of mercury, and at 32° F., a velocity of 57.8 miles per hour will indicate a velocity head pressure of 1 oz. per square inch. The coefficient, C, varies with the shape of the surface. For very large flat areas it will approach 2 as a maximum, while for cylindrical surfaces it may be as low as .62. In general for long rectangular surfaces, normal to the wind, it would be approximately 1.67.

3. *Stresses Due to the Breakage of Line Wires.*—If one wire breaks the resulting strain of dead-ending may be taken up in part by a torsional strain on the pole, and also by flexure of the pole, as well as by throwing additional strain on the other wires. However, should all the wires break (due for example to a burn-off), then if they do not slip through the tie wires the entire strain of dead-ending, on either side of the break, must be taken by the poles themselves. This will result in a flexure of the poles. However, a comparatively small flexure at the top of the pole will result in greatly relieving the strain on the wires, resulting in a flexure of less degree of the next pole, and so on, each pole being subject to a smaller strain than the preceding one nearer the break. Theoretically the strains from this cause would continue, with decreasing intensity, to the end of the line; or at least to a turn in the line. With a large number of poles per mile, calculations of this sort are of theoretical rather than of practical value, since an exceedingly small flexure will greatly relieve the strain; but where the length of span is great the problem becomes of considerable importance.

Certain pole lines have been constructed abroad where the poles have been designed with the special idea of making them flexible in the line of the wires to provide for just such a contingency as the breakage of the wires. In the solution of the problem certain assumptions and approximations will be made

which are entirely allowable to arrive at practical results.

Let Fig. 1 represent a pole line in elevation. The span of all the wires is normally the same. The poles, which are of uniform size, deflect different amounts at the tops, the deflection gradually decreasing towards the right.

T_0, T_1, T_2, etc., represent the stress per square inch in the wires in each span, each of which in the same span is assumed to be equally stressed. Let A = the net area of all the wires in a span. Assuming that we know the initial and final tensions in

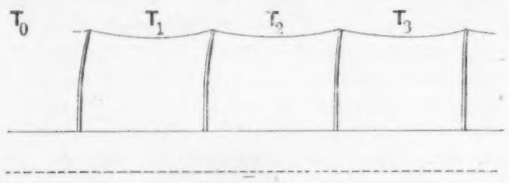


FIG. 1.—ELEVATION OF POLE LINE.

the wires between any given number of poles, as well as the original length of wire (unstressed), per span, we can determine the intermediate stresses and hence the stresses on the poles. If all the wires are burned off in one span then $T_0 = 0$. Assuming the tension T_m is the same as the original tension in the line before it burned off, the problem may be solved. The greater the value of m, the more accurate the solution.

Let $2y$ = length of normal horizontal span in feet.
x = length of normal vertical deflection in feet.
W = weight per square inch (one foot long) of the line wire.
A = sectional area of wire.
E = modulus of elasticity of the wire.
n = coefficient of maximum apparent increase in weight of wire due to wind and ice.
T = line tension per sq. in. before the wires break, when n has the above value, and the temperature is lowest.

T may be taken as the elastic limit of the line, if the wire be so strung.

Approximately
$$x = \frac{W n y^2}{2T}. \qquad (1)$$

Stressed length of wire
$$= l = 2y\left[1 + \frac{2}{3}\left(\frac{x}{y}\right)^2\right] \qquad (2)$$

Unstressed length of wire
$$= L = 2y\left[1 + \frac{2}{3}\left(\frac{x}{y}\right)^2\right]\left[1 - \frac{T}{E}\right] \qquad (3)$$

Assuming the deflection of the pole top is proportional to the difference of strains on the two sides, then for pole i (Fig. 2) the deflection will be $KA\ (T_i - T_h)$, where K is a constant.

Hence, the corresponding length of span between pole i and pole $j = 2y - KA\ (2T_i - T_h - T_j) = 2y_i$.

Substituting in (3):

$$L = \left[2y - KA\ (2T_i - T_h - T_j)\right]\left[1 + \frac{2}{3}\left(\frac{x_1}{y_1}\right)\right]\left[1 - \frac{T_1}{E}\right] \qquad (4)$$

The following quantities will be small in comparison with other terms, consequently their products may be neglected.

$KA\ (2T_i - T_h - T_j)$

$\frac{2}{3}\left(\frac{x_1}{y_1}\right)^2$

$\frac{2}{3}\left(\frac{x_1}{y_1}\right)^2$

$\frac{T_1}{E}$ and $\frac{T}{E}$

Hence, equating (3) and (4) and expanding

$$2y + \frac{4}{3}\frac{x^2}{y} - \frac{2Ty}{E} = 2y + \frac{4}{3}\frac{x_1^2}{y} - \frac{2yT_i}{E} - KA\ (2T_i - T_h - T_j).$$

Substituting from (1):

$$\frac{W^2 n^2 y^3}{3T^2} - \frac{2Ty}{E} = \frac{W^2 n^2 y^3}{3T_i^2} - \frac{2yT_i}{E} - KA\ (2T_i - T_h - T_j)$$

or
$$\left(\frac{2y}{E} + 2KA\right)T_i^3 + \left(\frac{W^2 n^2 y^3}{3T^2} - \frac{2Ty}{E}\right)T_i^2 - KA\ (T_h + T_j)\ T_i^2 = \frac{W^2 n^2 y^3}{3}$$

or
$$T_i^3 + b\,T_i^2 - c\ (T_h + T_j)\ T_i^2 = d \qquad (5)$$

where
$$b = \frac{E}{2y + 2EKA}\left[\frac{W^2 n^2 y^3}{3T^2} - \frac{2Ty}{E}\right]$$

$$c = \frac{EKA}{2y + 2KEA}$$

$$d = \frac{E}{2y + 2KEA}\left[\frac{W^2 n^2 y^3}{3}\right]$$

Under the assumed conditions, b, c and d are constants. Should all the wires be broken at span o, then $T_0 = 0$, and

$$T_1^3 + (b - c\ T_2)\ T_1^2 = d \qquad (6)$$

$$T_2^3 + [b - c\ (T_1 + T_3)]\ T_2^2 = d \qquad (7)$$

$$T_3^3 + [b - c\ (T_2 + T_4)]\ T_3^2 = d \qquad (8)$$

etc.

There are two methods of solving the problem: First, by assuming a certain pole fixed in position, in which event we may write this in the equation by equating the tensions on the two sides of the pole; and, second, by assuming the wires in a certain span, to be stressed to the tension T existing in the wires before they broke. For a very large number of poles the results would be the same, but where the number is small the first method gives too low, and the second method too high, figures. We are concerned with only the tension, T_1, which will cause the greatest strain on the pole. As a matter of fact, a consideration of one or two spans will in most cases give sufficiently accurate results. By figuring by both methods and taking the

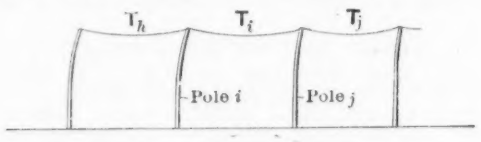


FIG. 2.—POLE DEFLECTIONS.

mean value, the results will usually be quite close to the correct value.

To take a practical example: A pole line of three No. 0 hard-drawn copper wires is stressed by wind and weather to the elastic limit of 32,000 lb. per square inch = T.

Span $= 2y = 600$ ft.
$E = 16{,}000{,}000$.
$W = 3.85$.
Assume $n = 2$.
$K = 1/5000$.
Then $A = .24$.
$b = -5100$.
$c = .36$.
$d = 4 \times 10^{12}$.

Solving by the first method, consider only one span. In equation (6) $T_2 = T_1$, and hence $.64\,T_1^3 - 5100\,T_1^3 = 4 \times 10^{12}$.

Solving $T_1 = 21{,}600$.

By the second method similarly we get, since $T_2 = T$:

$$T_1^3 - 16{,}600\,T_1 = 4 \times 10^{12}.$$

Solving $T_1 = 23{,}700$.

The mean value by the two methods is 22,650 and the corresponding strain on the poles is $.24 \times 22{,}650 = 5{,}440$ lb.

To take another example, assume the same data as above, except that $2y = 200$.

Then $b = 3{,}530$,
$c = .444$,
$d = .184 \times 10^{12}$.

By the first method consider one span:

$$.556\,T_1^3 - 3{,}530\,T_1^2 = .184 \times 10^{12}.$$

Solving $T_1 = 9{,}800$.

By the second method, consider one span:

$$T_1^3 - 17{,}750\,T_1^2 = .184 \times 10^{12}.$$

Hence, $T_1 = 18{,}300$.

The mean value of T_1 is 14,050. To be more accurate, consider two spans. By the first method:

$$T_1^3 - 3{,}530\,T_1^2 - .444\,T_1^2 T_2 = .184 \times 10^{12}$$

or
$$T_2 = \frac{T_1}{.444} - 7{,}950 - \frac{.414 \times 10^{12}}{T_1^2} \qquad (9)$$

and by (7) $.556\,T_2^3 - 3{,}530\,T_1^2 - .444\,T_1 T_2^2 = .184 \times 10^{12}$. (10)

Assuming different values of T_1, we get corresponding values of T_2 in (9). Substituting in (10) we can tell which values are correct. This is a cut-and-try method, but by proper use of the slide rule it is not difficult.

Solving $T_1 = 12{,}900$ and $T_2 = 18{,}600$.

Similarly using the second method, and two spans, equation (9) still holds, and also by (7),

$$T_2^3 - 17{,}730\,T_2^2 - .444\,T_1 T_2^2 = .184 \times 10^{12}.$$

Solving $T_1 = 15{,}400$ and $T_2 = 24{,}900$.

Taking the mean value of the results obtained by the two methods,

$$T_1 = 14{,}150 \text{ and } T_2 = 21{,}750.$$

This value of T_1 is within 1 per cent of its previous mean value, considering only a single span.

LINE CALCULATIONS.

In the issue of the ELECTRICAL WORLD of August 25, 1906, a method was given of calculating the strains in line wires, one of the main points of which was to determine in a practical manner the maximum vertical sag of the lines, which were so strung as not to be stressed beyond a certain amount under the most severe climatic conditions. The practical point in this connection was the necessary additional height of poles or towers, due to line sag, for long span work. It was shown, making certain assumptions allowable where the spans were not exceedingly great, that the relation between the span and the maximum sag could be reduced to a quadratic equation involving only the span and sag, provided certain constants, and weather conditions were known. This equation did involve also a coefficient n, which represents the number of times the apparent weight of wire is increased, due to wind and ice, and which thus entirely eliminated any direct consideration of the size of wire if n were known. Tables of the values of n were given, depending on the size of wire and weather conditions. If the maximum allowable stress be assumed as equal to the elastic limit of the material, then using the same constants as in the article.

For hard-drawn copper:

$$Y^2 = \frac{2.1\,X}{2.264 + .0453\,n^2 X}\left[1 + \sqrt{1 + 1.027\,X + .0205\,n^2 X^2}\right]$$

and for aluminum:

$$Y^2 = \frac{1.366\,X}{1.206 + .0218\,n^2 X}\left[\sqrt{1 + 1.3\,X + .0228\,n^2 X^2} - 1\right]$$

where

Y = span in hundred feet,

and

X = maximum, hot vertical, sag in feet.

Assuming different values of n, the relative values of X and Y can be determined and curves can be plotted therefrom. The following two tables and diagrams represent results as calculated on the assumptions previously made for copper and aluminum.

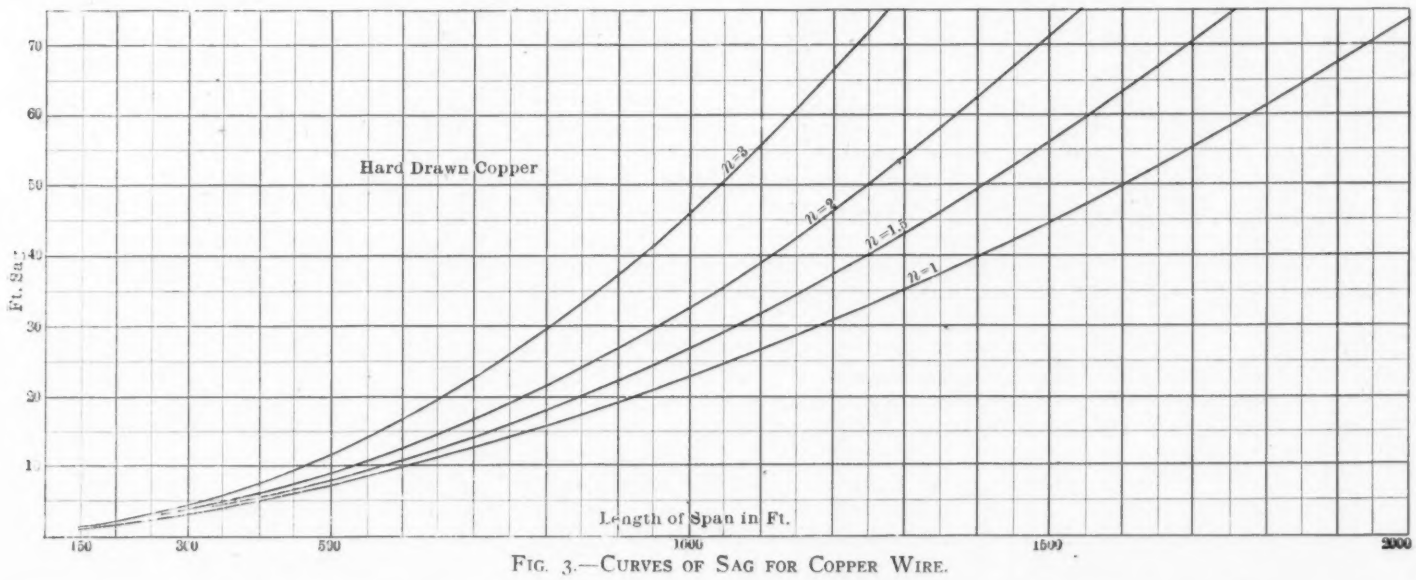


FIG. 3.—CURVES OF SAG FOR COPPER WIRE.

These calculations involve as one basis of assumption a temperature variation of 150° F. It is to be noted that when $n = 1$, the assumption of load on the wire is just that which is due to its dead weight. It is especially worthy of note that when $n = 1$, copper and aluminum under a span of 950 ft. have each 21 ft. sag, and that for shorter spans aluminum has a greater sag, while for longer spans it has a smaller sag than copper.

At first glance this seems rather remarkable, but on analysis it is seen to be partly due to the fact that in the shorter spans there is little percentage excess length, due to sag, and the high coefficient of expansion of aluminum has an important effect on the length of the wire, but it plays a much smaller part where the sag is considerable. Considering the fact that the weather has a much greater proportionate effect on aluminum than on copper, the former appears to be at a considerable disadvantage for the construction of long-span lines. For example, if the value of n due to wind pressure is 2.0 for hard-drawn copper, it would be 4.7 (nearly 5) for aluminum wire two sizes larger, and of practically equal conductivity. Under these conditions a span of 1,000 ft. would have a sag of 32½ ft. for copper and 54.8 ft. for aluminum—an increase of nearly 70 per cent over copper.

It may be regarded as an open question what is the safe max-

imum strain to be allowed on a line, and whether an approach to the elastic limit, under the worst conditions, is allowable. That is, theoretically, if the elastic limit be passed, the wire will stretch slightly and relieve the tension, but if there is a weak spot in the wire this may stretch and finally break. However, the coefficient n should be taken sufficiently large to cover the worst conditions which will occur, probably very seldom; if ever, viz.: maximum ice coating, minimum temperature and maximum wind velocity normal to the line—and this, in itself, is really an added factor of safety.

Allusion was made to the calculation of the most economic pole line in the article in the Electrical World of August 25, 1906. As an illustration assume a tower costs for insulators and material complete $\$80 + 2X + 1/40\,X^2$, what is the most economic pole line to use for hard-drawn copper when $n = 2$?

Relation between Span and Maximum Sag for Hard-Drawn Copper Wire.

100 Y = Span in feet for values of n given below.

x Max. sag in feet.	$n=1$	1.5	2	3
1	149	147	145	140
2	227	218	213	200
3	281	276	267	247
4	338	327	315	287
5	389	374	357	322
6	435	417	396	355
8	522	495	465	411
10	600	565	528	461
12	671	628	583	507
14	739	689	633	548
16	805	745	683	588
20	924	846	770	658
25	1060	961	870	737
30	1187	1060	959	808
35	1300	1160	1040	872
40	1410	1250	1113	935
50	1606	1410	1250	1045
75	2022	1756	1546	1280
100	2390	2044	1790	1480

Relation between Span and Maximum Sag for Aluminum Wire.

100 Y = Span in feet for values of n given below.

x Max. sag in feet.	$n=1$	2	3	5	8
1	76	76	75	74	71
3	201	197	192	177	160
5	309	300	283	252	219
8	441	427	397	344	289
12	623	572	520	440	363
16	777	697	615	518	423
20	917	810	717	587	477
25	1078	935	817	664	538
30	1232	1045	908	733	590
40	1496	1248	1068	856	686
50	1743	1422	1208	960	770
75	2270	1790	1506	1188	947
100	2710	2095	1770	1375	1093

Referring to the curve for copper, when $n = 2$:

			Cost of pole.	Cost per ft.
If X = 10,	$2y$ = span =	528.	$102.5	19.4c.
" 20,	" "	770.	130	16.9c.
" 30,	" "	959.	162.5	17.0c.
" 25,	" "	870.	145.6	16.7c.
" 23,	" "	833.	139.1	16.7c.

Hence, the pole line cost for a span of 528 ft. is 16 per cent higher than for a span of 833 ft.

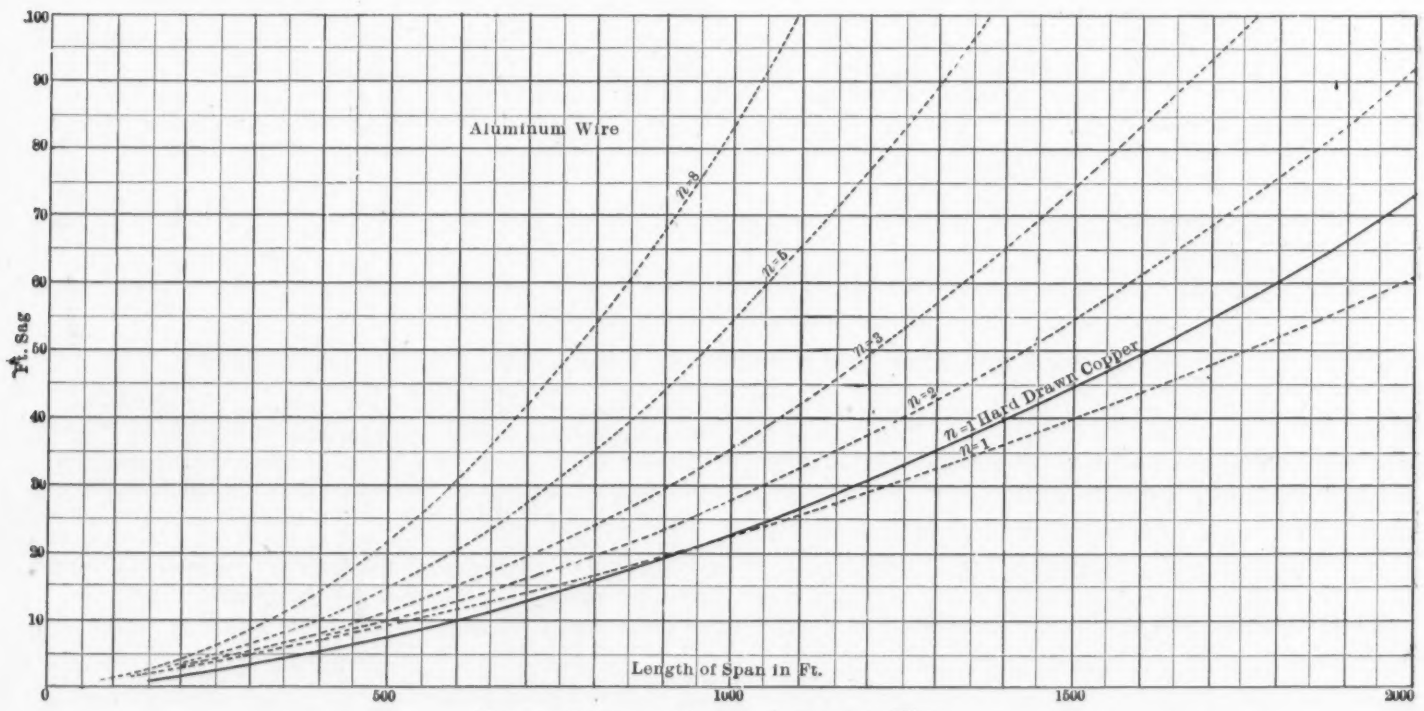


Fig. 4.—Curves of Sag for Aluminum Wire.

The Determination of the Mean Horizontal Intensity of Incandescent Lamps by the Rotating Lamp Method.

By Edward P. Hyde and F. E. Cady.

There are several methods in use at the present time for the determination of the so-called mean horizontal intensity of incandescent lamps, i. e., the mean intensity in the plane perpendicular to the axis of the lamp and passing through its center. The oldest of these methods, and one which is equally applicable to other light sources, consists in measuring the intensity at equal angular intervals in the horizontal plane, and either taking the mean of the observed values, or plotting the observations and determining the mean radius vector of the curve drawn through the plotted points. A second method particularly adapted to the incandescent lamp because of the constancy of its curve of mean horizontal intensity was developed from the first method as an abbreviation of it. According to this second method photometric measurements are made in a single fixed direction, and the mean horizontal intensity is computed from mean horizontal "reduction factors" previously determined for the different types of lamps. Dyke has recently shown(1), however, that even for lamps of a single type of filament individual differences of such magnitude occur as to produce serious errors in the computed values of mean horizontal intensity. This fact in conjunction with the inconvenience of the necessary orientation of the lamps on the photometer bar in making the measurements has rendered the method of little practical value, and consequently its use at present is quite restricted. In a modified form of this method which is used in Germany, the direct light in a definite direction from the lamp is supplemented by light reflected from two mirrors placed

(1) *Phil. Mag.*, Vol. 9, p. 136, 1905.

behind the lamp and inclined at an angle of 120° so that an illumination is produced on the photometer screen which is approximately proportional to the mean of the intensities in the three directions. Liebenthal has shown(2) the possible errors incident to this method, for the types of lamps studied, to be as large as 5 or 6 per cent when the lamps are definitely oriented, and 13 per cent when the lamps are set at random.

A third method, and one which is in almost universal use in this country in all practical determinations of the mean horizontal intensity of incandescent lamps, consists in spinning the lamp about its axis at a uniform speed of 180 revolutions per minute. The suggestion of spinning the lamp is said to have been made first by Prof. Chas. R. Cross at the National Electrical Congress held in Philadelphia in 1884, but the writers have been unable so far to find a record of such a suggestion. Thirteen years later the Committee on Standardization of the American Institute of Electrical Engineers, recommended(3) this method, suggesting a speed of 120 revolutions per minute. In recent years a speed of 180 revolutions per minute has been used quite universally, but an attempt to trace the authority for this modification has not as yet met with success.

A fourth method devised by Liebenthal(4) and used at the Physikalisch-Technische Reichsanstalt consists in rotating a pair of mirrors about the lamp held in a stationary position. The lamp is mounted with its axis horizontal and coincident with the photometric axis, the tip of the lamp being turned toward the photometer screen. The two mirrors, inclined at approximately 90 deg. to each other, reflect to the photometer screen light emitted from the lamp in a direction perpendicular to its axis. The direct rays from the tip of the lamp are prevented from reaching the photometer by a small screen. The mirrors rotate about the axis of the lamp and reflect to the screen a quantity of light proportional to the mean horizontal intensity of the source. This method necessitates, of course, the determination of the reflection coefficients of the mirrors, which is accomplished by means of a standard incandescent lamp whose mean horizontal intensity is known from a previous determination by the first method mentioned above.

Of the above four methods by far the most convenient in commercial testing is that of rotating the lamp, because but one measurement is required, and there is no question about the orientation of the lamp. Moreover by simple mechanical devices a reversal of the direction of rotation may be obtained so that lamps fitted with screw bases can automatically be screwed into and out of the socket, thus materially lessening the time required for measurement. Although the method of rotating the lamp is the most convenient it has been open to serious objection which has never been answered satisfactorily, so that while the method is in quite general use in this country, there are many who are in doubt in regard to its accuracy and its adoption abroad has been restricted.

The two possible sources of error of this method are (1) the possible distortion of the filament, (2) the effect of the flicker which is perceptible in nearly all types of lamps when rotating at 180 revolutions per minute, and which is extremely bad in those types in which the horizontal distribution curve deviates greatly

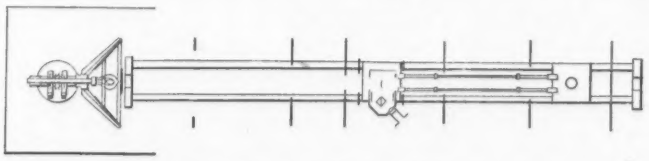


FIG. 1.—DIAGRAMMATIC SKETCH OF PHOTOMETER BENCH, SHOWING ROTATING MIRRORS IN HORIZONTAL POSITION.

from a circle. Besides the possible error produced by the flicker the accuracy of a setting is diminished considerably and the eye is rapidly fatigued.

In order to determine definitely the errors due to distortion of the filament and to the flicker, an investigation has recently been carried out in the Photometric laboratory of the Bureau of Standards. The results of this investigation will be discussed fully in the next number of the *Bulletin* (Vol. 2, No. 3). In the following paragraphs a brief résumé of the results will be given.

A pair of rotating mirrors (see Figs. 1 and 2) somewhat similar to those described above as in use at the Reichsanstalt, but with one essential difference, were constructed in the instrument shop of the Bureau. Instead of mounting the lamp in a stationary position between the mirrors, the apparatus was so designed that the lamp could be rotated about its axis, quite in-

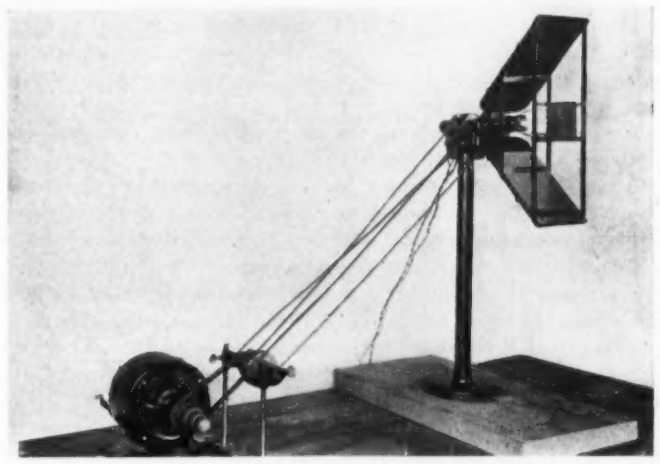


FIG. 2.—VIEW OF ROTATING MIRROR.

dependently of the rotation of the mirrors. This arrangement obviated the necessity of a separate determination of the coefficient of reflection of the mirrors, which is liable to error unless the mean horizontal intensity of the standard lamp employed is obtained by the point to point method from a very large number of readings. Although the rotating mirror system was made quite rigid the precaution was taken to show that the reflection coefficient of the mirrors was the same whether they were rotating or stationary.

The following series of observations was made with lamps of a number of different types: (a) mirrors rotating at a speed sufficiently high to eliminate flicker (in some cases over 800 revolutions per minute), lamp at rest; (b) mirrors rotating at 180 revolutions per minute, lamp at rest; (c) mirrors at rest, lamp rotating at 180 revolutions per minute; (d) mirrors at rest, lamp rotating at 500 or 600 revolutions per minute; then the entire cycle in the reverse order. In all the measurements in order that the observer at the photometer should not be influenced by his readings, a second observer noted and recorded the settings on the bar, and the observer at the photometer was not informed of the results until the entire series of measurements had been completed. If there were no errors due to bending and no error due to flicker, all four of the above sets of readings would be the same. A comparison of (a) and (b) shows the effect of flicker separated from that of distortion of the filament; a comparison of (a) and (c) shows the combined error due to flicker and bending at 180 revolutions per minute. This combined error is that which occurs in practice when measurements are made on lamps rotating at 180 revolutions per minute. A comparison of (b) and (c) shows the effect of bending at 180 revolutions per minute; and a comparison of (a) and (d) shows the effect of bending at 500 or 600 revolutions per minute.

In all, ten different types of incandescent lamps were studied, including a 50-volt lamp, a 220-volt lamp, tantalum lamps and seven types of 110-volt carbon filament lamps. The results for the individual lamps will be reserved for the more detailed paper in the *Bulletin*. The general results can be stated briefly under the two heads, "Effect of Bending" and "Effect of Flicker."

EFFECT OF BENDING.

At speeds of 500 or 600 revolutions per minute very appreciable changes in the mean horizontal intensity due to bending were observed, in some cases the effect being to decrease the mean intensity, in others to increase it. The greatest difference due to bending was observed in a "double carbon" filament which had accidentally been rotated for a few seconds at about 800 revolutions per minute and was afterwards brought to a speed of about

(2) *Zeit. für Instrumentenkunde*, Vol. 19, p. 193; 1899.
(3) *Trans. Amer. Inst. of Elec. Eng.*, Vol. 14, p. 90; 1897.
(4) Loc. cit.

600 revolutions per minute. This lamp showed a decrease in mean horizontal intensity of about 2 per cent, but after the lamp was stopped rotating it was noticed that one loop of the filament had touched the bulb and had sealed itself there remaining permanently in that position. Except for this one lamp the greatest decrease in mean horizontal intensity at a speed of about 550 revolutions per minute was 1 per cent, which was the value obtained for another lamp of the "double carbon" filament type. The greatest increase in horizontal candle power due to bending was about 0.8 or 0.9 per cent for a "downward light" type of filament at 550 revolutions per minute. The anchored oval filament showed a slight decrease due to bending amounting to about 0.5 or 0.6 per cent at 550 revolutions per minute. At a speed of 180 revolutions per minute the effect of bending amounted in no case to more than a few tenths of 1 per cent.

The tantalum lamp showed a queer effect which it is interesting to note in passing. Although one might expect a decrease in mean horizontal intensity on rotation, no such effect was found, the observations indicating a slight increase. The magnitude of the effect was small but since in every one of a number of determinations the sign of the effect was the same it is probable that there is a real increase in mean horizontal intensity. The peculiar feature to which attention should be called, however, is the apparent increase in resistance of tantalum lamps on rotating them. At least a half-dozen lamps were tested, each of them several times, and without exception, on rotating the lamps the current decreased although the voltage was maintained constant. The amount of change was not the same for all lamps, nor indeed the same at different times for any one lamp, but ranged from one per cent to only a few tenths of one per cent.

EFFECT OF FLICKER.

The most surprising results of the investigation were found in studying the effect of flicker on the apparent mean horizontal intensity of the different types of lamps. The common oval anchored type of filament shows comparatively little flicker when rotating at 180 revolutions per minute, and consequently, when small differences between sets (a) and (b) were found they were ascribed to observational errors, since the difficulty of setting with a flickering light is much greater than when the fields of view in the photometer appear steady. When, however, with other types of lamps differences amounting to 4 per cent occurred it became evident that the effect was not to be ascribed to the probable error of observation, for every one of 5 or 10 readings with the mirrors at high speed would lie entirely without the limits of the readings at 180 revolutions per minute. Moreover, with different observers the effect of the flicker was found to be quite different. Thus while one of the writers read the flickering light about 4 per cent too high the other read it about 3 per cent too low, a difference of 7 per cent. Moreover, each observer persisted in his habit so that when, about this time, a number of lamps submitted for test were measured it was subsequently found on looking over the results that while the values obtained by the two observers agreed excellently for most lamps, there were large differences, always in the same direction, for lamps in which there was a disagreeable flicker.

Other observers were tried, some of them experienced in photometry, and all experienced observers in other lines of physical investigation, but in almost every case there was a decided preference for either higher or lower values with the flickering light. All of the measurements referred to above were made with a Lummer-Brodhun contrast photometer, and in every case there was a color match on the two sides of the screen. Subsequently a number of measurements were made by three observers with a very good Leeson disk furnished the Bureau by the Electrical Testing Laboratories of New York. Strangely enough, with this photometer each of the three observers changed the sign of his error as compared with his measurements on the Lummer-Brodhun photometer. Of course the error of observation with a badly flickering light, such as is obtained with a "double flattened" filament or a "downward light" filament is quite large, but there is no question in the writers' minds but that the error due to flicker is a very definite one, characteristic of the individual. It would not seem, however, that the effect is a true physiological effect in the same sense as Talbot's law for non-flickering illuminations. It is not that different eyes integrate a flickering light differently, but rather that they do not integrate at all. The explanation would seem to be this: Due to the inability of the eye to integrate a flickering light, an infinite number of different independent intensities are perceived. On any one of these a setting could be made, but having chosen some one point in the series of fluctuating intensities the criterion persists, and the more observations the individual makes the more probable it is that he will continue to set in the same way. One of the observers previously mentioned was conscious of two different criteria by either of which he was able to make consistent settings. According to one criterion he set too low; according to the other too high.

Apart from the explanation of the effect of flicker the important fact which the investigation makes clear is that, in the case of lamps in which the horizontal distribution curve deviates considerably from a circle so that a bad flicker results when the lamp is rotated at 180 revolutions per minute, some other method for determining the mean horizontal intensity must be employed. Otherwise large errors amounting to many per cent may arise. Since all of the types of lamps investigated stood up very well under the high speed of 500 revolutions per minute and the effect of bending was in no case more than 1 per cent, it was thought desirable to investigate possible errors incident to the determination of mean horizontal intensity by rotating the lamps at a speed double that in use at present, i. e., at 360 revolutions per minute. Before doing this, however, some experiments were made on the mchanical effects of such a speed on lamps the filaments of which had drooped due to prolonged burning in a horizontal position. Three 50-cp, 110-volt lamps, each of which had burned several hundred hours and had fallen in intensity below 80 per cent of its initial value, showed excessive drooping. In one lamp the filament was not more than 3 or 4 mm from the bulb; in each of the other two the filament was about 5 or 6 mm. from the bulb. These lamps, which had long heavy filaments and which had given evidence of their susceptibility to bending under the influence of mechanical forces by their excessive drooping under the action of gravity, would seem to represent the most unfavorable case for a high speed rotation. The lamp in which the filament was within 4 mm of the bulb stood a speed of 300 revolutions per minute. At about 350 or 400 revolutions per minute the filament touched the bulb, and melting it at the point of contact allowed air to enter which caused the lamp to burn out. The other two lamps were rotated at increasing speeds up to about 650 or 700 revolutions per minute before the filament touched the bulb, in each case the result of the contact being the same as before. Since these lamps would probably have been rejected on most specifications before dropping to 80 per cent because of the excessive drooping, it would seem that a speed of 360 revolutions per minute would be quite safe in all practical cases. Although measurements made on different types of lamps indicated no determinate permanent change in the horizontal intensity the effect of continued burning while rotating at a speed of 360 revolutions per minute was not investigated.

After showing that a speed of 360 revolutions per minute would probably produce no serious mechanical difficulties, samples of those types of lamps in which the effect of flicker is most pronounced and of those in which the bending is greatest, were measured at that speed in order to see whether the errors due to flicker could be obviated without introducing prohibitive errors due to bending. It was found that in several types of lamps the flicker was still so pronounced that differences of several per cent were obtained. It was therefore concluded that either a higher speed must be used, or some other method employed.

Since it would not seem feasible to increase the speed much above 360 revolutions per minute an attempt was made to devise some other method by which an increased accuracy could be obtained. The following considerations suggest a method which was put in practice and found to be quite satisfactory. The error due to the flicker is a function not only of the speed but of the difference between the maxima and minima of the flickering light. No matter how great this difference the flicker will cease at sufficiently high speeds, but if the difference is small the error due to the flicker will be relatively small at all speeds, and will entirely disappear when the speed has been increased

even to a moderate value. In those types of lamps in which the error due to flicker was found to be large the differences between the maxima and minima are great, amounting in one type to 70 per cent, so that if in some way the extreme fluctuations in the intensity of illumination on the photometer screen could be lessened the resultant error would be diminished.

Except in the case of anomalous lamps extreme differences in intensity in different directions are not due to bad centering of the filament or to any effect connected with a displacement of the effective center of radiation from the axis of rotation—fluctuations due to these effects would in general be relatively small. The irregularity of the horizontal distribution curve is due primarily to the shape of the filament, and consequently, except for sharp reflections from the bulb, or sharp shadows produced by the obscuration of parts of the filament, the maxima lie 180 deg. apart, and the minima approximately at right angles to the maxima. Hence if to the illumination produced by the direct light from the lamp on the photometer screen, an illumination produced by light emitted in a direction normal to the photometric axis be added, the resultant illumination will show a relatively small variation on turning the lamp. If the lamp is rotated at the customary rate of 180 revolutions per minute the flicker will be much less disagreeable and productive of error than that incident to the direct light alone when the lamp is rotating at double this speed.

In order to accomplish the above result in practice a single stationary mirror (Fig. 3) was placed in such a position that

FIG. 3.—DIAGRAMMATIC SKETCH, SHOWING SINGLE STATIONARY MIRROR IN POSITION.

light emitted at right angles to the photometric axis was reflected by the mirror and was incident on the screen in conjunction with the direct light from the lamp. Measurements made on the "downward light" lamp at 180 revolutions per minute by the two observers who had previously differed by about 7 per cent at this speed showed an agreement well within the range of the error of observation which was probably less than one-half of one per cent. In a similar way the error due to flicker in all types of lamps in which the maxima and minima lie approximately at right angles to each other would become quite small even at a speed of 180 revolutions per minute. Although the results of the investigation at the Bureau show that a single mirror is sufficient for the types of lamps studied, it is possible that other arrangements of mirrors might be devised that would also eliminate the flicker.

One or two round bulb, "double round coil" filament lamps which had burned to 80 per cent in life test, and which were unique in having most of the carbon deposit concentrated on a small part of the bulb showed bad flickers even with the addition of the mirror. This was to be expected, as measurements showed that, due to the absorption of the concentrated carbon deposit there was a difference of 40 per cent between the intensity in the direction of the deposit and in a direction 180 deg. from the deposit. With such anomalous lamps a very high speed must be used or some other method employed, such, perhaps, as the addition of one or more mirrors. It would scarcely seem justifiable, however, to reject a very convenient method for a few sporadic lamps.

A more serious question is that of the practical applicability of the single stationary mirror method in consideration of the difference in path between the direct ray from the lamp and the ray by way of the mirror. The details of the mathematical investigation of this point will be reserved for the subsequent paper, but the result may be stated briefly. Assuming the two lamps at fixed positions, if the substitution method of measurement is employed (according to which the standard lamp is placed at the beginning of the measurements in the same position as the test lamps), and if in computing the candle-power scale a distance intermediate between the distance of the lamp and the distance of its image from the screen be taken as the effective distance of the lamp, the resulting errors for a large range of distance on either side of the middle point of the bar, will be entirely negligible. Of course with the mirror method a 32-cp lamp would be most convenient for use as a comparison lamp.

Factors Determining the Design of the D'Arsonval Galvanometer.

BY L. A. FREUDENBERGER.

THE shape of the bobbin of a D'Arsonval galvanometer should be as shown in Fig. 1—two cylinders with their elements touching along the axis of suspension. The above shape gives the least moment of inertia (the period of vibration of the coil is least), for a given sensibility.*

The method by which the following equations are deduced can only be indicated in a general way, owing to lack of space.

For the purpose of analysis, the bobbin is considered to be

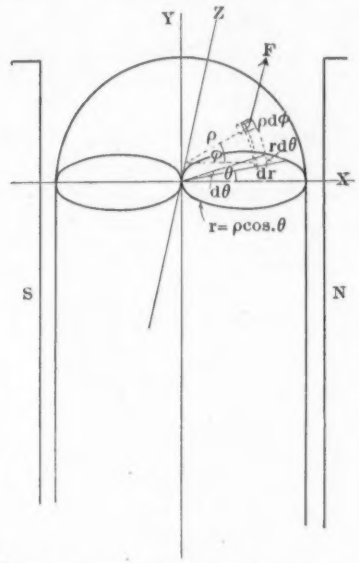


FIG. 1.—PROPER SHAPE FOR BOBBIN OF D'ARSONVAL GALVANOMETER.

divided into two parts, the straight cylindrical portions, and the (ring) end portions. The force acting on a wire is given by the well-known equation, $F = ilf$, where i is the current, l the length of wire, f the strength of field; the force, F, length, l, and strength of field, f, being mutually perpendicular.

The torque acting on a differential volume of wires in the bobbin is first deduced, and then the total torque is obtained by integration for the whole bobbin—straight portions and ends.

The resisting torque due to the suspension is $b\phi$, where ϕ is the angle of deflection and b is a constant having the value

(1) $b = \dfrac{4\pi^2 K}{\tau^2}$, where K is the moment of inertia and τ is the period of vibration.

(2) Equating the two equations for the torque gives

$$i = \frac{32}{\pi} \frac{k^2 a^2}{f \rho^3 [l + \frac{5}{8}\pi\rho]} \cdot b\phi.$$

In the above expression, ρ is the diameter of one of the cylindrical straight portions, l is twice the length of the straight portion of the bobbin, a is the radius of the bare wire, and k is the ratio of diameters of the wire, bare and covered; that is, $k = \dfrac{a + c}{a}$, where c is the thickness of the covering. In deriving the above expression the wire is assumed to be wound in square order.

The total resistance of the bobbin is next deduced and is

(3) $R = \dfrac{\rho\rho^3}{16\, k^2 a^4}(l + \pi\rho)$, where ρ is the specific resistance of the wire.

Eliminating a^2 in the equation (2) by means of (3), gives

(4) $$i = \frac{8}{\pi} \frac{k}{f\rho^2} \frac{(l + \pi\rho)^{1/2}}{(l + \frac{5}{8}\pi\rho)} \frac{\rho^{1/2}}{R^{1/2}} \cdot b\phi,$$

thus showing that high current sensibility is secured by the use of large coils (ρ large) wound to a high resistance. The large

*Grays Absolute Measurements, p. 380.

coils, however, would have a large moment of inertia and a long period of swing. Practically, the length of the period of oscillation is strictly limited, and it becomes necessary to

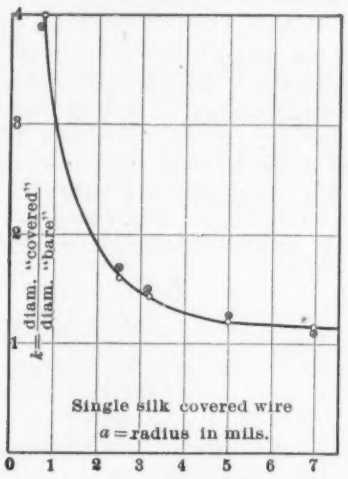


FIG. 2.—RELATION BETWEEN SIZE OF WIRE AND ITS COVERING.

design a coil of maximum sensibility for a given period of swing.

The total moment of inertia of the bobbin is:

$$(5) \qquad K = \frac{3}{32}\,\pi\,\delta\,p^4\,[l + {}^7/_{12}\,\pi\,p],$$

where δ is the mass of the bobbin per unit of volume. This value of K is substituted in (1) giving a value for b which is substituted in (4), giving an expression for i as a function of p. Also by means of (3) p can be expressed in terms of k and a, thus giving finally the following expression for the current:

$$(6) \qquad i = 3\,\pi^2 \frac{[16]^{5/6}\left[\frac{l}{p} + \frac{7}{12}\,\pi\right]}{\left[\frac{l}{p} + \frac{5}{8}\,\pi\right]\left[\frac{l}{p} + \pi\right]^{1/3}} \frac{\delta\,k^{8/3}\,a^{10/3}}{f\,\pi^2} \frac{R^{1/3}}{\rho^{1/3}}\,\phi.$$

In making the above transformations, the quantity $\frac{l}{p}$ is merely a ratio; also the value of the term

$$\frac{\left[\frac{l}{p} + \frac{7}{12}\,\pi\right]}{\left[\frac{l}{p} + \frac{5}{8}\,\pi\right]\left[\frac{l}{p} + \pi\right]^{1/3}}$$

in (6) continually decreases as $\frac{l}{p}$ is increased. Thus the ratio of length to breadth of the bobbin of a D'Arsonval galvanometer should be as great as possible. Among commercial bobbins $\frac{l}{p}$ ranges from 15 to 25.

In Fig. 2 are plotted values of k for different values of a, for single silk-covered wire; a being the radius of the bare wire in mils. k approaches unity as a limit, as the size of wire is increased. Then the equation between k and a has the general form

$$k = Ca^n + 1,$$

where C and n are constants.

Under these conditions the curve in Fig. 2 is represented with sufficient exactness by the following equation:

$$(7) \qquad k = \frac{2.06}{a^{1.84}} + 1.$$

Eliminating a in (6) by means of (7) and equating to zero the first derivative of i with respect to k, for minimum value of i, gives $k = 14.8$ and $a = 0.242$ mils, corresponding to wire about ½ mil. in diameter. The smallest commercial wire is only 1.5 mils. in diameter.

The above result thus points to the use of the smallest obtainable wire for winding the bobbins of D'Arsonval instruments. This confirms practice, in that 1.5 mil. wire is used for medium and high resistance instruments.

From equation (6) it is seen that for the same periods of vibration a low resistance instrument would be slightly better, as a current indicator, than a high resistance instrument both wound with the same size of wire. To use a low resistance bobbin, however, would require a very fine suspension fibre (smaller than about 1.5 mil. diameter) in order not to reduce the period and consequently the sensibility.

Recent Electrochemical Developments.

Among the electrochemical patents granted last week were three for electric furnace processes. Mr. F. J. Tone patents details of construction of long electric furnaces, in which connections to the outside circuit are made through terminals at the ends, the current passing from one terminal to the other either through a conducting core or through the charge. The carborundum furnace is an example. At the high temperature which prevails in it, the masonry which comprises the base of the furnace becomes a conductor and considerable part of the current is shunted off through the base and is thus wasted. Mr. Tone prevents this by artificially cooling the bottom of the furnace. For the sake of convenience he constructs the walls in sections with reinforcing frames so that they are at the same time permanent and movable.

The well-known process of making calcium carbide is based on the reaction between lime and carbon, resulting in calcium carbide and carbon monoxide. Mr. J. M. Matthews substitutes calcium chloride for lime and in treating a mixture of calcium chloride and carbon in an electric furnace, he produces calcium carbide and calcium tetrachloride (the carbon tetrachloride taking the place of the carbon monoxide in the preceding formula). Calcium chloride is a cheap by-product of chemical manufacturers while carbon tetrachloride is a valuable solvent and has come considerably into favor in recent years.

Mr. F. M. Becket utilizes the affinity of calcium for sulphur for reducing molybdenite in a single operation to metallic molybdenum without roasting. For instance, the treatment of a mixture of molybdenite lime and carbon yields molybdenum, the sulphur of the ore being taken care of by the calcium and the carbon. Calcium carbide may also be used directly as a reducing agent, a mixture of molybdenum and calcium carbide being treated in this case in the electric furnace.

A patent by J. H. Robertson refers to details of mechanical construction of storage battery plates for subsequent electrochemical formation. By means of special tools horizontal recesses of special form are cut into the plate so as to produce a large active surface.

New Telephone Patents.

SWITCHBOARD CIRCUIT SYSTEM.

F. G. Bell, of London, England, has obtained patents for a circuit system for common battery switchboards in which each line has a relay which serves for line signal for supervisory and for retardation through which to feed the battery. This is brought about through peculiar jack and plug arrangements. The jacks carry numerous springs, one of which is a switching spring only. One plug of each pair is shorter than the other, having but two parts instead of three like the other. Where the three parts are used the forward one is dead, serving merely to switch contacts in the jack.

PARTY LINE LOCK-OUT SYSTEMS.

Two patents at hand represent the step-by-step party line department. One of these describes a system using a power-driven cylinder at each station, all of which under control move simultaneously to connect desired stations. This is the invention of A. Marchand, of Buckingham, Wash. As a novel feature it has a means of resetting stations manually.

The second patent is granted to Messrs. F. J. Ravlin and J.

Lofgren, of Chicago. The step action of the selector in this instrument works with a snap action so that it is independent largely of the duration of the current impulses.

AUTOMATIC EXCHANGE IMPROVEMENTS.

Senders for automatic switchboards have been of many types, usually, however, tending toward some sort of revolving arm or dial. N. E. Norstrom, of Chicago, has now patented one in which all motions are longitudinal. The face plate is in the form of a slide which can be moved along to correspond in different positions to different hundreds of numbers. This plate itself carries perforations for the different individual numbers and a slider is pulled to the proper position indicated by the desired number. It will thus be seen that the slider's position when set depends upon the set of the face plate as well as of itself. The Globe Automatic Telephone Company has been assigned an interest in the patent.

A. H. Dyson, of Chicago, has patented an arrangement for the simultaneous signaling of a large number of stations of a system and upon their response for the delivering of any message to all. This has been worked out for an auxiliary to an automatic system. The control of the lines to be signalled lies in a set of relays, one for each line. These when energized cut their respective lines upon the general circuit. The relays are controlled from one or more of the various subscriber stations of the system. Mr. Dyson has assigned his patent to M. G. Kellogg, of Chicago.

Another "automatic" patent is one granted to John Erickson, of Chicago, describing an arrangement of relays for automatic systems to prevent any detrimental reaction from the ringing currents. This relates entirely to systems wherein the selection of a subscriber requires the related action of several selectors. The patent is assigned to the Automatic Electric Company.

Two other patents assigned to the same company have been issued to A. E. Keith, of Chicago. Both relate to the multiple selector systems. In these it has heretofore been customary to group the various selecting machines together according to their type, namely, first selectors all together; second selectors, etc. This has a disadvantage in tracing a call through an exchange because of the scattered apparatus involved in it. Mr. Keith's arrangement involves grouping the selectors in working sets, so that apparatus related for any single call shall all be together.

In all such systems the selectors which select trunks to other selectors, in the act of building up a connection, make the selection of the lowest number non-busy trunk automatically. This is done usually with the assistance of an intermittent current, common to the exchange. Some difficulties of adjustment arise from this arrangement, and because of this Mr. Keith supplies continuous current, and arranges each interrupter to time its own supply automatically. The switching of the circuits is controlled by the actual motion of the selecting arm and the act of switching takes place only upon the completion of one unit movement.

MISCELLANEOUS APPLIANCES.

A pressed sheet steel transmitter arm has been invented by H. J. Guttman, of Chicago. This takes the usual shape for wall set arms except that the forward end is expanded to form the rear part of the transmitter casing. A sheet metal base is also provided, ears being bolted upon this. These ears are formed to clamp the arm with considerable friction and yet to prevent any but rotary motion in a vertical plane.

A cap for transmitter mouthpieces has been patented by W. A. Patterson, of Chicago. The cap fits over the mouthpiece and has a central opening which may be covered by a shutter. When it is desired to shut off all sound from the transmitter the shutter is closed.

N. J. Tubbs, of Louisville, Ky., is the inventor of an antiseptic device for desk stands. A shelf supports an antiseptic pad in a position such that when the receiver is on its hook its mouth rests upon the pad. At the same time a linkage from the hook switch swings an antiseptic disc across the mouthpiece.

While receiver supporting arms have been almost without practical use, still patents continue to appear for them. A new type invented by F. F. Howe, of Marietta, Ohio, forms the subject of a recent patent. The receiver supporting arm is linked to the transmitter arm and the base end of this latter operates the switch springs. When the receiver is adjusted to the user's ear the transmitter arm is correspondingly moved, operating the switch. In order to improve the efficiency of conversion D. H. Wilson, of Chicago, has devised multiple core induction coils of several designs. He has covered these in two patents. It is not evident upon inspection just how the gain in efficiency is brought about.

LETTERS TO THE EDITORS.

Wind Pressure.

To the Editors of Electrical World:

SIRS:—I have read with interest the editorial comment in your issue of September 20 on the researches published by Dr. Soldati and myself on air resistances, and beg to offer the following further details:

First, I beg to explain that the results on cylinders apply to the middle region of long cylinders (cylinders infinitely long) as Mr. Bowie rightly supposed; second, our cylinder was 48 mm. (about 2 in.) and not 6.8 mm. in diameter, so that for transmission wires which are much thinner, further experiments should be made.

Our point-by-point method has proved successful also in the hands of the Royal Italian Corps of Engineers, who are studying balloons and propellers, but its chief value according to my opinion lies rather in supplying detailed data by means of which some physicist deeply versed in the theory of fluids may possibly replace present theories by one which could better represent *facts*. Until theory can foresee and represent such distribution of pressure as takes place on a sphere moving through water on air, it cannot be of much use for less simple cases, and must necessarily contain some fundamental erroneous assumption which should be corrected as soon as possible.

The long and tedious research we have conducted had primarily the object of procuring accurate data for the design of flying machines. In this respect I do not think we have obtained any result that should radically affect the present course of invention. It may rather interest your readers to learn that if the practical side of our research has not been continued, the cause has been on one hand pressure of other work incidental to the development of single-phase electric traction; and on the other hand the definite knowledge since acquired, that, not far from my own place of work, and along lines I consider rational, a very distinguished inventor and engineer is producing designs by which the great practical problem of aerial navigation will—as I hope and believe—soon be solved.

MILAN, ITALY. GEORGI FINZI.

Swedish Engineers.

To the Editors of Electrical World:

SIRS:—Your issue of October 27 contains a notice that a movement towards the organization of a "Scandinavian Engineers' Union" has been started in Dresden, Germany, and that such an organization has been warmly welcomed by the Scandinavian press. This welcome, however, has by no means been unanimous; in fact it has been confined to Norway and Denmark. *Svenska Dagbladet*, a leading Swedish daily paper, and *Teknisk Tidskrift*, the organ of the Swedish Technical Society, have both, and the writer thinks justly, published several articles in direct opposition to this "Scandinavian Engineers' Union." Of the 197 Scandinavians mentioned in your notice as studying in Germany, it is safe to say that the Swedes, although contributing by far the largest part of all "Scandinavian engineers" (if such a term has any *"raison d'être"* whatever) will number less than 5 per cent. The reason is that Sweden educates its own engineers, having an excellent technical college, to which the Swedish engineers owe their high reputation for professional knowledge the world over, and especially in this country. Institutions of such standing Norway and Denmark lack, and their sons with technical inclination, therefore, as a rule, go abroad to obtain their education.

This "Scandinavian Engineers' Union" has consequently been promptly unmasked by the Swedish press as a plain attempt to let all Scandinavian engineers pass under the same label, and thereby unjustly to share in and benefit by the reputation that the Swedish mother college and its alumni, through hard and conscientious work, have earned for the Swedish engineering profession.

The "American Society of Swedish Engineers," which to-day has 220 members, was organized in 1888 with headquarters in New York, and has, all through the past 18 years, shown remarkable energy and ability to work for a high standing among Swedish engineers in this country. The society has made application for a home in the Engineering Societies' Building, which application is reported to have been favorably considered by the authorities.

Every step towards a better understanding between the Scandinavian peoples is highly laudable and should receive the heartiest encouragement, but trespassing one upon another's ground was never beneficial to the friendly relations between neighbors.

Milwaukee, Wis. J. E. Fries.

Motor-Generator Fly-Wheels.

To the Editors of Electrical World:

Sirs:—In your issue of June 30 Mr. Rudolf Braun, of Manchester, England, related a history of the Ilgner system tending to show that he was the real author of this system. As Mr. Braun, however, neglected several important points, I think it desirable to present here the correct history of a system which is now applied to nearly 100 hauling engines and five reversible rolling mills.

In the spring of the year 1901 the Donnersmarkhutte, at Zabrose, O. S., gave me the specifications for a hauling engine installation in the Abwehr colliery, for which I was the consulting engineer.

The Donnersmarkhutte Company did not intend to ask for a proposal from the Westinghouse Company at Berlin, with which I had a connection in addition to my work as a consulting engineer; in order, however, to give this company an opportunity to look into the matter I sent it the data, which were forwarded to the Westinghouse Company at Pittsburg. A proposal was subsequently received from it, but did not receive favorable consideration.

In the meantime I had personally worked on the same project, and when Mr. Braun came to visit me at Breslau my new system was ready. A witness to this fact is Mr. Huldschinsky, of Breslau, Koernerstrasse, who was also a representative of the Westinghouse Company at that time. I gave to Mr. Braun the details of my system, which he promised me to keep secret as I intended to exploit it. Mr. Braun, however, communicated the matter to the Westinghouse Company at Berlin and worked out a project, the details of which are now in my possession. This project, which recommended the combination of a fly-wheel and a storage battery, was not accepted by the Donnersmarkhutte Company.

Simultaneously with the submittal of their project the Westinghouse Company asked me for full particulars of my system, so that they could take over my patent; and when I refused them, having worked out the project while acting in the capacity of consulting engineer, they let the matter drop, saying that they had worked out a better system. In the spring of 1902, however, the Westinghouse Company again tried to get control of my patent, but their claim was refused by the Patent Office.

Not "soon after," but in May or June, 1902, a full year after I made my invention, did I sever my connection with the Westinghouse Company and enter the service of the Donnersmarkhutte Company.

In addition to the above statement I believe it will be sufficient to present the following three facts:

First, the Westinghouse Company asked the data of the new system from me and not from Mr. Braun.

Second, Mr. Braun apparently does not know that the Ward Leonard system, which was employed by me, was well known in Germany as long ago as the exhibition at Paris.

Third, Mr. Braun apparently does not know that Ilgner patents are filed in a large number of countries, including England.

Vienna, Austria. Carl Ilgner.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Turbo-Generators.—Rosenkoetter.—An illustrated description of some details of construction of four-pole turbo-generators built by an English company, with a capacity of 1,500 kilovolt amperes running at 1,500 r.p.m., the voltage at the terminals being 6,600. The special feature is the construction of the revolving field core with its excitation winding of copper ribbon.—*Elek. Zeit.*, October 25.

Single-Phase Motors.—Bragstad and Smith.—The conclusion of their article on calculating the characteristic curves of single-phase series commutator motors. In this installment the authors give, as an illustrative example, the calculation of the characteristic curves of a 75-hp single-phase series motor.—Lond. *Elec.*, October 26.

Three-Phase Current Diagram.—Niethammer.—The conclusion of his article on a general diagram for all kinds of three-phase machinery.—*L'Eclairage Elec.*, October 13.

Lamps and Lighting.

Osram Lamp.—The Welsbach Co., of Berlin, has now placed the osram lamp on the market. It is sold at present for 32 cp, 50 cp, and 100 cp, and for voltages between 100 and 130. The average life is 1,000 hours, and the specific consumption one watt per hefner candle or slightly more. The price in Germany is 75 cents for a lamp with the shape of the ordinary globes used for carbon-filament lamps up to 34 cp; from 34 to 52 cp, 81 cents; of 100 cp, $1.25. The 100-cp lamps of spherical shape sell for $1.38. For frosted globes the price of lamps below 100 cp is raised by 4 per cent. Nothing is refunded for lamps that burn out. The decrease of illumination during the life is very small, being only about 4 per cent. The osram lamp can be used at present only in a vertical position. The osram filament, like the tantalum filament, is sometimes able to weld together after being broken. For voltages above 130, two or more lamps must now be used in series. The osram lamp is equally good for alternating current and direct current. The company expects to improve the lamp so that it will not be necessary in future to use it in a vertical position only. It is hoped to make lamps for 220 volts and 40 cp or more, whereby the lamps have almost the same specific consumption and the same life as the lamps now placed on the market. It is intended to make lamps up to 200 cp. The results of various tests are given with abstracts of some articles all of which have been noticed before in the Digest.—*Jour. f. Gasbel.*, October 20.

Power.

Efficiency of Generating Stations.—Evans.—A note on the comparison of efficiencies of different electrical generating stations. The author explains why he considered as unsatisfactory a comparison based on the cost of coal per Board of Trade unit, or a comparison based on the pounds of coal per Board of Trade unit. A much more satisfactory basis is Brit. thermal units per Board of Trade unit. "For example, in the case of a station consuming 7 lb. of coal—having a calorific value of 14,000 British thermal units per pound—per Board of Trade unit—the British thermal units per Board of Trade unit are 98,000." From this he passes over to the thermal efficiency which is defined as the ratio of British thermal units in a Board of Trade unit, to the British thermal units in the coal consumed per Board of Trade unit. Since one Board of Trade unit is equal to 3,414 British thermal units the thermal efficiency in the above

example becomes the ratio of 3.414 to 98,000, or 3.48 per cent. —Lond. *Elec. Rev.*, September 28.

Steam Turbine.—GIBSON.—A concise review of the present status and probable future development of the steam turbine. A table is given of the latest test figures for steam turbines of different makes, from which it appears that the steam consumption in pounds per electric hp-hour varies between 11.0 and 15.4.—*Cassier's Mag.*, November.

Electric Motors in Flour Mills.—A note on the recent installation of electric motors in an English flour mill. The installation represents 2,000 hp, three-phase currents at 440 volts and 40 periods being used. All the motors are three-phase induction machines.—Lond. *Elec. Eng.*, October 19.

Traction.

Single-Phase Traction in England.—A few notes on what appears to be the first use of the single-phase system on an English road. The length of line to be equipped with single-phase traction is 8 miles of double track on the Midland Railway. The voltage on the single-phase system will be 6,600 with step-down transformers in the motor cars, reducing the voltage to 320 for supply to the motors. The contract for the generating station has not yet been let. Each motor car will be equipped with compensated series single-phase motors with special commutation poles, the rated output of each motor being 180 hp and the efficiency about 83 per cent including gear losses with a power factor of about 92 per cent. The primary side of the transformer will be controlled by an electrically operated main switch. This will be opened by the master-controller when in the off position, so that the transformer will not be in circuit all the time. For starting, the voltage of the motors will be varied by connecting them to various contacts on the transformer by means of various electrically-operated transformers placed under the car and controlled by the driver.—Lond. *Elec.*, October 26.

Single-Phase Traction.—HEWETT.—A very full illustrated description of the Toledo & Chicago interurban single-phase railway on which power is distributed at 33,000 volts and 3,300 volts are used on the trolley.—*St. Ry. Jour.*, October 13.

Single-Phase Traction.—A fully illustrated description of the single-phase railroad in the exposition in Milan. As has already been noticed in the Digest, Finzi single-phase motors are used with a construction similar to interpole motors.—*Elek. Zeit.*, October 11.

Electric Railway Practice.—Various elaborate and fully illustrated articles reviewing modern practice of the interurban roads with respect to rails, joints, bonds, dies, crossings, signals, etc.; the latest practice in rolling stock, design and equipment for interurban roads; modern practice in power station design and transmission, use of storage batteries, selection of voltages, equipment of sub-stations and portable sub-stations; modern practice in the construction of high-tension transmission lines for interurban roads, etc.—*St. R'y Jour.*, Columbus Convention Issue.

Rome.—SOLIER.—An illustrated description of a new tramway system serving the suburbs of Rome. The total length is 125 miles, and the ordinary trolley system is used.—*L'Eclairage Elec.*, October 20.

Installations, Systems and Appliances.

Three-Phase Versus Direct Current.—SUCHY.—In cases where a distant water power is to be utilized, three-phase current will, of course, be chosen. On the other hand in a compact district and whenever a storage battery is absolutely necessary, the direct-current systems will be selected. The author does not take such cases into consideration, but compares the first cost and the cost of maintenance of two central stations which are working under similar conditions, one with three-phase currents, the other with direct current. The latter is assumed to have no storage battery. Plants of medium size, that is, from 50 to 500 kw capacity are assumed. The results of the comparison of cost of construction and operation are given in diagrams, in which curves are plotted with kilowatts as abscissæ and the distance of the power station from the center of the consuming district (that is, the length of the main transmission) as ordinates. The curves in these digrams represent the distance for which the cost of the direct-current system is just equal that of the three-phase system. Various curves are given in each diagram corresponding to different numbers of generating sets.—*Elek. u. Masch.*, October 14.

Financial Results of German Central Stations in Small and Medium-Sized Cities.—DETTMAR.—While in stations serving more than 100,000 inhabitants electric central stations have proven profitable in Germany, very little exact statistical data exist concerning the results in smaller towns. From the statistical data published by the German Association of Electricity Works, Hoppe has found that the results in smaller towns are very discouraging (as has been described in detail in the Digest). For instance, for stations with a capacity of from 100 to 250 kw, corresponding to from 4,000 to 8,000 inhabitants, Hoppe finds a mean gross earning of 5.5 per cent and for stations below 100 kw corresponding to less than 4,000 inhabitants, a mean gross earning of 3.97 per cent. (From the tables given in this article it appears that what is here called mean gross earning, "Brutto-Erträgnis," is found simply by deducting the expenses for wages and salaries, and for operation and maintenance from the receipts for energy sold and for meters rented, and by giving this difference in percents of the capital invested). The present author, who is the general secretary of the German Association of Electrical Engineers, shows that these results do not represent average conditions, and that the statistics on which they are based are not sufficiently representative. For instance, the results of Hoppe for plants with a capacity below 100 kw are based on the results of five plants, while there are in Germany about 700 or 800 plants of this size and the five given in the statistics of the Association of Electricity Works are by no means representative since special conditions prevailed there, as shown in detail. The present author has collected more statistical material by inquiry from a great many stations and the results are given in numerous tables. For cities of from 1,000 to 5,000 inhabitants new data are available for 64 cities in which the gross earning varies from 19.7 per cent to minus 0.6 per cent, while the average is 8.4 per cent. All the plants in which the gross earning is less than 8 per cent are called by the author bad plants, and those in which the gross earning is 8 per cent or more are called by him good plants. By a comparison of both classes of plants he finds that the bad plants show in general a somewhat greater first cost and that they also have low receipts. Further, the mean ratio for wages and salaries to the receipts is 15.9 per cent in good plants, and 20.2 in bad plants. The old and new data now available for 75 cities of from 1,000 to 5,000 inhabitants show a mean gross earning of 7.8 per cent, which is not bad, especially if it is taken into consideration that eleven of these plants show a gross earning of more than 13 per cent, hence they are quite profitable. The author's statistics show that it is possible even in cities of as low as 1,000 inhabitants, to get good financial results from an electricity plant, also that the existence of a gas plant in a town by no means prevents the financial success of an electric station. The main point, however, which the author makes with great emphasis, is that in smaller stations it is absolutely necessary to keep wages and salaries as low as possible. It is very difficult to make a commercial undertaking profitable if about 20 per cent of the receipts are spent for wages and salaries. In some small German stations as high a percentage as 40 is reached. In general, it is absolutely necessary to keep this average below 20 per cent, and by paying particular attention to this point, some smaller stations which were unprofitable before have been rendered profitable. Small stations are not as favorably situated as larger ones. The cost of operation is high since they cannot use automatic machinery to the same extent and will also have to pay more for fuel, etc. Further, in these days of incandescent lamps of greatly improved efficiency, large stations have nothing to fear since experience shows that the introduction of more efficient lamps and therefore cheaper lighting very materially increases the amount of electric energy sold in large towns. On the other hand in smaller stations the applications of electric lighting are limited and it is quite questionable whether it will be possible to materially increase the energy consumption in a plant by introducing a very much more efficient lamp. The author believes that this will be possible only in cities which have a gas works in addition to an electrical station, since cheaper electric light will induce consumers to substitute electric light

for gas. In other cities of small size electric stations must expect rather worse financial results from the high-efficiency lamps. In small plants the attendants required at hours of peak load cannot be held uniformly busy during the whole day. The expense for wages is a considerable percentage of the whole receipts. Further the amortization for machinery which is used for a few hours only is in this case a larger item than with large works. These items of expense are far more important than the small saving which can be obtained by extreme utilization of the heat values of the fuel and by pushing the efficiency of the machines to extreme values. It is necessary to find something to do for the attendants as well as for the machines during the hours when the load is low. If it is possible to find some secondary occupation for the attendants for which no or only little capital must be invested, and to earn in that way $750 per year, in a plant for from 1,000 to 5,000 inhabitants, a saving of 2 per cent can be made since the mean capital investment for a plant of this size is $37,500. The author's chief recommendation is that all the large technical works or engineering works in a small town should be placed in charge of the same engineer, that is, for instance, the electric station, the gas plant, the water works, and perhaps also the slaughter house, etc. In this case it will be easy to shift the workingmen from one plant to another when necessity arises, and to keep them fully occupied during the whole day. For instance, water works have their maximum load in the evening and in winter. It will thus be easy to obtain considerable saving, but this will be only possible if all the different works are in charge of the same engineer. Another source of income for electric stations is the wiring and installing of lamps and motors in houses, but this is to be recommended only in cities in which no electrical firms exist who do that work. The inquiry of the author has shown that a small city was able to make in this way yearly $1,500 and to increase thereby the gross earning by 4 per cent. In the city of Quedlinburg this one means has resulted in increasing the gross earning from 5.75 per cent within one year to 11.37 per cent. There would not be much money in the sale of carbon-filament lamps from the stations, but the situation may be changed by the new and more expensive high-efficiency lamps, and the loss in receipts for the sale of electrical energy may be compensated by the earnings in the sale of the lamps. In new plants the possibility of combining a refuse destructor with the station should also be considered. In many towns it will pay to provide charging apparatus for electric automobiles. A very suitable though small source of income is the equipment of an electric bath house which requires little room and is a perfect substitute for steam baths which in general are not to be had in smaller cities. The author even recommends the running of a complete bath house in combination with the electric station since warm water is always available from the boiler house, etc. It may also pay in some cases to push connections of ice machines to an electric distribution system or to combine a whole ice factory with the station. The inquiries of the author show that out of 127 cities of small size, 76 cities have such secondary sources of income, although they consist mostly in the sale of lamps, motors, etc. There are several works which in this way have increased the gross earnings up to 75 per cent. It is, of course, necessary in small cities to have as simple a tariff as possible. With the aid of good bookkeeping care should be taken to buy cheaply and to utilize all materials properly. For districts where peat is available, attention is called to recent processes for the gasification of peat. It is stated that in one plant 1 hp-hour was produced from one kilogram of peat, "the calorific value of the peat being 3,600 units." —*Elek. Zeit.*, October 18 and 25.

Wires, Wiring and Conduits.

Coils of Bare Aluminum Wire.—Hopfelt.—A paper read before the Dresden Electrical Society. Aluminum is covered in air at ordinary temperature with an oxide film which protects it against the influence of weather and of many chemicals. This oxide film is an electric insulator and resists an e.m.f. of 0.5 volts. It is therefore possible to wind coils of bare aluminum wire, the single turns of one layer touching each other, without danger that the current will pass directly from one turn over to the next turn as long as the voltage difference between the two is not more than 0.5 The different layers of the coil must, of course, be separated from each other by some insulating material. When such a coil has been wound it is impregnated with water and current is sent through it in order to produce a strong film of oxide on the surface of the wire.—*Elek. Anz.*, October 14.

Preservation of Timber.—Some notes on various methods for the preservation of wood—principally for railway sleepers and for transmission line poles, with reference to an exhibit at the recent Milan exhibition. Details are given of successful methods of impregnating railway sleepers with creosote, either completely or partially. For the preservation of poles for transmission lines, impregnation with copper sulphate has been extensively used, but this impregnation must take place within a few days of felling the tree. Uniformly good results have been obtained by impregnation with corrosive sublimate, involving simply immersion in the liquid for from ten to fourteen days. From German official statistics it appears that the average life of such poles is about 17 years, compared with 14 years for poles treated with copper sulphate, and to from 6 to 7 years for natural poles.—From *L'Electricita*, abstracted in Lond. *Elec.*, October 12.

Calculating Alternating-Current Lines.—Blondel.—The author has formerly given formulas for calculating transmission lines having both resistance and self-inductance, both for single and polyphase currents. He now extends his former formulas so as to include the effect of capacity which appears on long lines. After giving the fundamental formulas, he translates them into diagrams. The paper is to be continued.—*L'Eclairage Elec.*, October 27.

Line Construction.—Kallir.—The first part of a paper read before the Austrian Association of Central Stations giving formulas for the construction of high-tension lines with iron poles. —*Elek. u. Masch.*, October 21.

Extending Networks.—Prohaska.—An article showing how to estimated the probable financial returns resulting from projected extensions of networks of transmission lines.—*Elek. Anz.*, October 21.

Electro-Physics and Magnetism.

Spark Potentials in Liquid Dielectrics.—Earhart.—An account of an investigation of the spark potentials for small distances in liquid dielectrics. Transformer oil, kerosene oil, and olive oil were tested. The chief results are as follows: The potential gradient for very small distances is higher than for large ones. For small distances air is a better insulator than liquid dielectrics. The potential at which the bend in the potential-distance curve occurs is the same for air and liquid dielectrics.—*Phys. Rev.*, November.

Coercive Force.—Gumlich.—An account of experiments made in the Reichsanstalt. The author has found by means of magnetometric measurements with an ellipsoid that for a magnetically soft material the whole form of the magnetizing curve depends considerably on the question whether the magnetization is changed continuously or by steps and on the size of the steps. The author's present investigation relates especially to the coercive force which is found to depend for soft material in a large degree on the size of the steps by which the magnetizing current is changed. The coercive force is a maximum for continuous change of magnetization and a minimum for immediate commutations. This relation holds approximately good also for the energy losses due to hysteresis.—*Elek. Zeit.*, October 25.

Conductivity of Air in an Electric Field.—Ewell.—An account of an experimental investigation of the conductivity of air, self-ionized in a strong electric field. Alternating current was used and the results are given in diagrams with the volts as abscissæ and milli-amperes as ordinates. The lower portions of the curves show the well-known rapid increase of current with slight increase of potential, while in the upper portions two facts are conspicuous. The first is that as the ionization current in the air increases, the electromotive force necessary to maintain the current decreases, and second that as the current increases, the curves for the different distances approach each other. The first result shows that when the current is increased beyond the values represented by the familiar lower portions of the curves, the air under normal conditions exhibits so-called negative resistance which has hitherto been demonstrated only under conditions of

high temperature (the arc discharge) and low pressure. The results of the author may be applied to the theory of the Siemens ozonizer and the complete electrical characteristics of any type of Siemens ozonizer may be calculated from the formulas of the author.—*Am. Jour. of Sci.*, November.

Roentgen Rays.—HAGA.—An account of an experimental investigation of the polarization of Roentgen rays with special reference to a former investigation of Barkla. The experiments relate to both primary and secondary rays, and the results give further proof of the conclusion that Roentgen rays consist in transverse vibrations.—Lond. *Elec.*, October 12.

Electro-Chemistry and Batteries.

Fixation of Atmospheric Nitrogen.—JUMEAU.—An illustrated summary of various processes which have been proposed in recent years for the production of nitrogen oxides from air by means of electric discharges. The descriptions are taken mainly from patent specifications.—*La Rev. Elec.*, October 15.

Units, Measurements and Instruments

Constancy of Batteries Giving Currents.—WHITE.—A description of a method of increasing the constancy of batteries giving currents. The disposition of the cells is shown in Fig. 1. Branch (1) contains a battery and a resistance box. The voltage in this branch is V, and the resistance B. Branch (2) contains another battery of smaller voltage, v, and of resistance, b. Branch (3) contains the apparatus through which it is desired to send constant current or current at constant voltage. Its resistance is R. By proper adjustment of the resistance, B, it is possible to

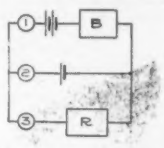


FIG. 1.—ARRANGEMENT OF CELLS.

make the current through branch (2) as small as desired, and therefore to keep the battery in that branch constant. At the same time the value of the current through (3) can be made to depend largely or entirely upon the constant battery (2), and only slightly, or not at all, upon the battery in (1), which sends the current. The mathematical formulas which determine the conditions to be maintained are given.—*Phys. Rev.*, November.

Ballistic Galvanometers.—ZELENY.—An account of precision measurements with the moving-coil ballistic galvanometer. This type possesses an important advantage over the stationary-coil type in that it is free from ordinary internal magnetic disturbances, but it presents a number of difficulties for work of high precision. The constant of a moving-coil galvanometer is a variable quantity depending on several conditions. For work of the highest precision the unknown quantity must be compared with a known one of nearly equal magnitude and the two throws must be obtained in immediate succession. A set in the fibre must be avoided by always taking the throws in the same direction and stopping the motion of the coil on its return before it crosses the null point. The mica condenser is by far the most convenient working standard for the comparison of electrical quantities. A number of precautions are pointed out which must be taken in order to employ the moving-coil galvanometer with ease for measuring electrical quantities to the highest degree of accuracy attainable with direct-deflection methods.—*Phys. Rev.*, November.

Direct-Reading Conductivity Bridge.—APPLEYARD.—A description of a direct-reading instrument for the measurement of the electric conductivity of rods of such material as iron, steel and alloys. The instrument eliminates the end-contact resistance of the test-rods and provides for the compensation of small differences of diameter or of mass between test-rods. The principle is indicated in Fig. 2. The advantage of this arrangement is that in all positions of the slider the necessary condition for the Kelvin principle to hold good is maintained automatically. In the actual instrument, only the middle portions of the two parallel slide wires are exposed. In Fig. 3, which shows one form of it, these exposed portions of the wires are seen at the lower part of the bridge-board, near the middle. The unexposed portions of the slide-wires are wound respectively upon four bobbins beneath the board, the ends being connected to R_1 and R_2, as shown in Fig. 2. The resistance, R_1, is a standard rod of known conductivity; R_2 is a test rod of unknown conductivity, balanced against R_1. The length of the test rod is known, and is con-

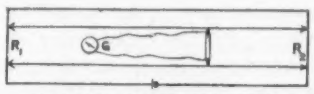


FIG. 2.—DIAGRAM OF CONDUCTIVITY BRIDGE.

stant, being the distance between the two fixed clamps shown in the upper part of Fig. 3; the nominal diameter or mass of the wire is known, and its actual diameter or mass is measured as part of the test. The standard wire, R_2, is seen in Fig. 3, extended the full length of the board, just beneath the long scale. Below it, in Fig. 3, is a parallel stout copper bar carrying a single slider which makes contact with the standard wire. To obtain a

FIG. 3.—DIRECT-READING CONDUCTIVITY BRIDGE.

balance, the length of R_1 is varied by moving this slider. The double slider, represented in Fig. 2 is used, in this form of the instrument, only for compensating for small differences of diameter or of mass between any given test-wire and the nominal diameter or mass. This double slider appears at the bottom of Fig. 3 near the middle. A battery key and a galvanometer key complete the apparatus so that it is only necessary to attach a low-resistance galvanometer and a battery to the terminals marked for the purpose in Fig. 3.—Lond. *Elec. Rev.*, October 26.

Direct-Current Meter.—SCHWARTZ.—The first part of an illustrated description of a compact and cheap amperehour meter for small lighting installations.—*Elek. Anz.*, October 21.

Transformers for Instruments.—An article on the determining features in the design of current transformers for instruments. —Lond. *Elec. Rev.*, October 12.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—SCHMIDT.—An account of an investigation in which the author repeated Marconi's experiments with wireless telegraphy in a certain direction by the use of horizontal instead of vertical receiving wires. The author endeavored especially to measure the energy transmitted by means of Fessenden barretters, which were connected in the well-known manner in the form of a Wheatstone bridge. By increasing the bridge current, he could increase the sensitiveness of the barretters so much that alternating currents of about 0.0000001 to 0.00000001 amp. could be measured. Tables are given showing the effect of varying the direction of a horizontal receiving wire with a vertical transmitting wire; the effect of varying the lengths of the horizontal receiving wire, and the effect of varying the height of the horizontal receiving wire over the earth. With respect to the latter effect he found that the higher the horizontal wire above the earth the greater the energy received; on the other hand, the effect which a variation of the direction of the receiving wire has, is simultaneously decreased. In Marconi's system a much smaller part of the transmitted energy is utilized in the receiver than in ordinary systems of wireless telegraphy.—*Elek. Zeit.*, September 13.

Wireless Telegraphy.—FRANKE.—A paper read before the Berlin Electrical Society giving a brief review of the present status of wireless telegraphy, its principles, methods and apparatus. By means of experiments the author showed how even with complicated oscillation processes the determining factors, frequency, degree of coupling, damping, etc., have become available to exact measurement.—*Elek. Zeit.*, October 25.

Wireless Telegraphy.—SLABY.—A reply to the recent article of Wien. The author very strongly objects to Wien's criticisms of his serial of articles on wireless telegraphy, which he claims to be thoroughly unfounded and unfair. In a foot-note the editor states that the discussion is now closed.—*Elek. Zeit.*, October 18.

Electrical Equipment of a Modern Cement Plant.

Of the many applications of electric motors in manufacturing establishments there is probably no industry where the power demands are more exacting or the operating conditions more severe than in cement works. The heavy starting torque required by cement making machinery, the nature of the load handled, the constant presence of dust and the inflammability of pulverized coal used in the manufacture of cement, bring up problems in power transmission that require the most careful consideration. The most natural solution of the various problems is the adoption of induction motors, as is aptly illustrated by the plant of the Bath Portland Cement Company at Bath, Pa. This plant was designed for an output of 2,500 barrels of cement per day and is a typical example of modern practice in this industry.

The buildings are compactly situated on four acres of ground and are constructed of concrete and steel, the extensive use of concrete being regarded as consistent with the cement business. The power house is built 10 ft. above the ground level, the lower part being used as a basement, which contains steam and air pipes, cables, overflow conduits from condensers and a receiving tunnel from the reservoir.

FIG. 1.—VIEW OF INTERIOR OF POWER HOUSE, SHOWING ELECTRIC GENERATOR AND ROPE DRIVE FOR POWER TRANSMISSION.

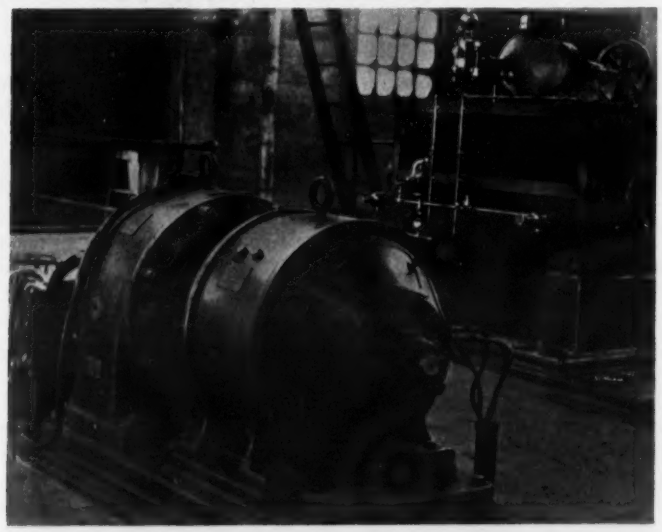


FIG. 2.—MOTOR-GENERATOR EXCITER SET.

The engine and generator equipment consists of a 350-hp Wetherell-Corliss tandem-compound, condensing engine direct-connected to a Westinghouse 200-kw engine-type, three-phase, 60-cycle, 440-volt generator operating at 120 r.p.m., and two 1,100-hp, cross-compound engines of the same make, located parallel

FIG. 3.—GRAVITY TRAMWAY.

to each other, employed to drive the raw mill department and the clinker department. These engines are of the heavy duty Corliss type. Each is fitted with a sheave fly-wheel 18 ft. in diameter and 67¾ in. face, which drives twenty-two 2-in. transmission ropes connected to sheave wheels on the main line shaft. To this line shaft are belted two 180-kw, 440-volt, three-phase, 60-cycle generators operating at 514 r.p.m. Fig. 1 illustrates the engines and generators. All three engines are equipped with the consolidated Engine Stop Company's apparatus, and any unit may be stopped from several places in the works in case of accident.

A small lighting set consisting of a 10-kw, engine-type, direct-current, 125-volt generator is direct-connected to a Reeves vertical engine operating at 400 r.p.m.

Fig. 2 is a view of a motor generator set used for excitation. It consists of a 15-hp induction motor, 400 volts, 1,120 r.p.m., direct-connected to a 10-kw, 125-volt, direct-current generator.

In order that a clear idea of the manufacture of cement and the various applications of electric motors in such industries may be gained, it may be well to give a description of the various processes from the time the rock leaves the quarry until the cement is packed in barrels.

In the quarry vertical holes are drilled into the solid rock by pneumatic drills in which the blasting charges are placed and ignited by electricity. The loosened rock is conveyed to the mill in cars by means of gravity and are dumped into two No. 6 Austin gyratory crushers. The empty cars then run to the foot of an incline where an endless chain driven by a 10-hp induction motor draws them to the top, and they return to the quarry by gravity, as illustrated in Fig. 3. Each car has a capacity of four

tons, and an average of seventeen cars per hour are handled.

After the stone has been suitably crushed and dried it is placed in bins in the raw mill. In the raw grinding room there are 16 Fuller-Lehigh mills driven from the line shaft that operates the machinery in the stone house, each mill having its independent clutch. Large storage bins, located over the mills, empty directly into their feed hoppers, ample room being provided for any necessary repairs. In passing through the mill the material is delivered into a screw conveyor located in a tunnel beside the mill foundation which empties into an elevator in the

FIG. 4.—MOTOR-OPERATED COAL FEEDERS.

kiln house. In this house the machinery is driven by a line shaft belted to a 100-hp induction motor operating at 580 r.p.m. This motor also drives a 22.5-kw, 125-volt, direct-current exciter which supplements the exciters in the engine room proper.

The kiln house connects with part of the raw grinding room, and the rotary kilns are placed transversely across the building. Each kiln is revolved from the line shaft by means of a Mosser speed regulator of the interlocking-cone pattern controlled by a tight and loose pulley that also controls the feeding of the raw material from the storage bins.

At the delivery end of the kiln, the clinker discharges into a pit, forming a chute that empties into three bucket elevators, one elevator being used for two kilns. The clinker is then elevated and discharged into three clinker coolers 10 ft. in diameter and 40 ft. high. The elevators are operated by a 30-hp induction motor.

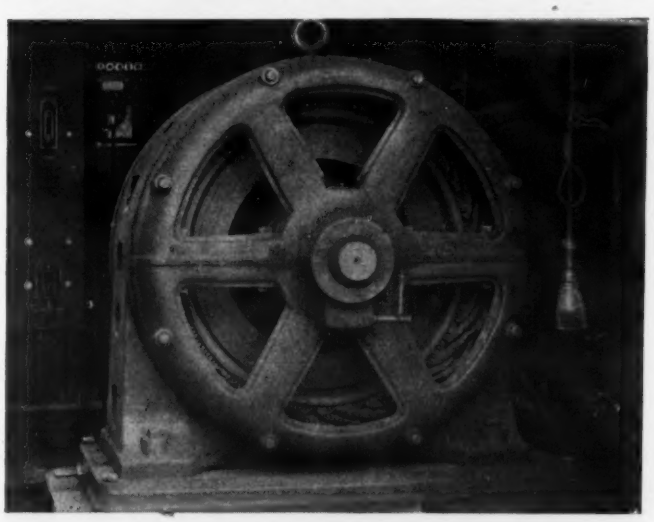


FIG. 5.—200-HP MOTOR BELTED TO MACHINERY IN COAL HOUSE.

The coolers are arranged with spouts which deliver the clinker into conveying machinery that extends to the clinker storage where the clinkers are well seasoned before grinding.

Fuel for the kilns consists of pulverized coal which is forced through pipes from the feeders to the burners. The feeders, six in number, are each operated by a 1-hp induction motor, as illustrated in Fig. 4.

The clinker, after passing through the pot crushers in the clinker storage house, where it is mixed with gypsum is conveyed to two sets of clinker-crushing rolls, where it is reduced to about the size of peas, then elevated and conveyed to bins over 24 Griffin mills where it is ground to cement. After the clinker-grinding room comes the cement stock house where the finished product is stored, and the packing house. All of the machinery in the stock and packing houses is operated by a 100-hp induction motor.

In the coal pulverizing plant where the coal for the kilns is prepared, into the Mosser crushing roll, then into a bucket, all of the machinery is driven by a 200-hp induction motor, Fig. 5. A machine shop operated by a 10-hp induction motor, where all repairs are made, completes the equipment of one of the most modern cement plants in this country.

The credit for the successful design and operation of the plant is due to Mr. Frederick B. Franks, superintendent and chief mechanical engineer, and Mr. James A. Gish, his assistant. The electrical equipment throughout was supplied by the Westinghouse Electric and Manufacturing Company.

Voltage Regulator for Both Alternating and Direct-Current Systems.

The latest type of Chapman voltage regulator, illustrated herewith, may be applied to various purposes. It may be used, first, either for alternating or direct-current generators, for regulating the voltage output and maintaining it constant at the busbars or at a distant end of the line. Secondly, the regulator may be applied for controlling the voltage delivered by a storage battery, maintaining it constant on a circuit for lamps and motors. Or the regulator may be used in the reverse manner for controlling the storage-battery charging current, keeping it constant. Finally, the regulator is suitable for controlling the voltage of individual lamp circuits or motors which are fed from a variable source of supply.

The regulator is composed of three essential parts—a relay for detecting small changes of voltage or of current and applying

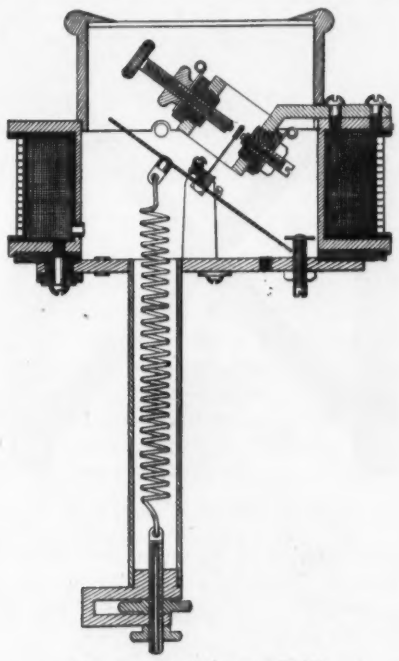


FIG. 1.—SECTION OF RELAY.

the corrective force; a rheostat, and a pair of working solenoids for operating the rheostat switch in response to the movements of the relay.

The relay consists of a coil wound upon a brass spool. Within the coil is a thin iron disc pivoted at opposite ends of a diameter. Due to the magnetic force set up by current passing through the coil, this disc tends to turn so that its plane will be along the axis of the coil, but is opposed in its motion by the spring shown.

This spring is under tension, and is controlled by means of the thumb-screw and lock-nut shown at the bottom. This device enables a close adjustment of the voltage to be made, as to produce a change of one volt requires that the thumb-screw be given merely a fraction of a turn.

Attached to this rotating disc is a spring having platinum contacts at the end. This, due to the motion of the disc one way or the other makes contact at one or the other of two adjustable fixed contact points, which close the circuit through the controlling solenoids. These points are also tipped with platinum, and are protected from dust by means of a metal cover with a glass top. Two resistance lamps are placed in series with the relay coil for cutting down the current and for compensating for temperature changes. The temperature coefficient of resistance of the lamps is negative, while that of the coil is positive. In this way errors due to changes in temperature are avoided.

The two solenoids are carrying current only when the circuit is completed by means of the relay, so that they are in operation only a small part of the time. They have two windings—a primary, which carries the operating current; and a secondary, wound in the same direction. The latter is short-circuited upon itself, and its function is to prevent arcing at the relay contacts, this

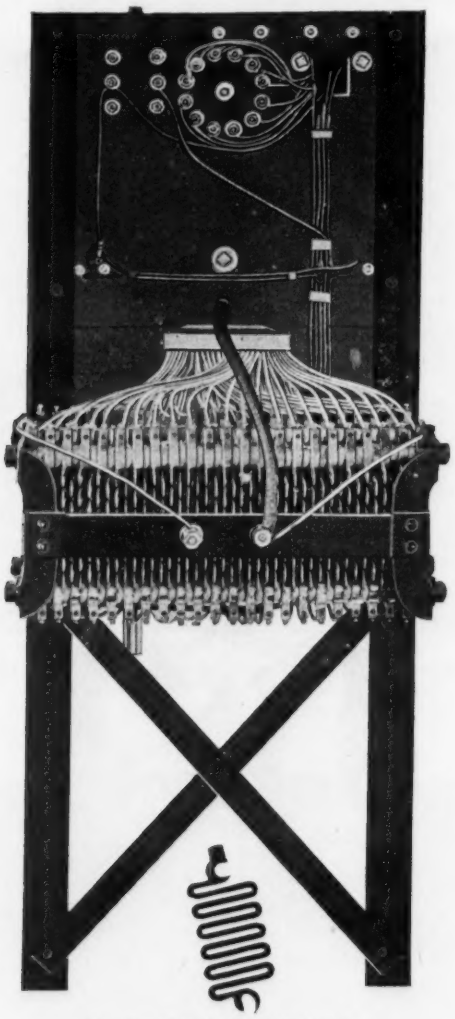


FIG. 2.—VOLTAGE REGULATOR.

being done by the reaction of the secondary current induced when the circuit is broken. There is, in addition, a pair of high-resistance lamps connected up so as to absorb any little discharge remaining after this action.

The rheostat by means of which the circuit is controlled is made in two types. For small currents the resistance is built up of a set of enameled resistance units, while for larger sizes the resistance units are cast-iron grids.

To prevent oscillatory motion of drifting of the regulator, a dashpot is attached to one of the solenoid cores. This is a simple device, and by means of an ingenious arrangement the dashpot ports are opened or closed by a slight turn of the cylinder.

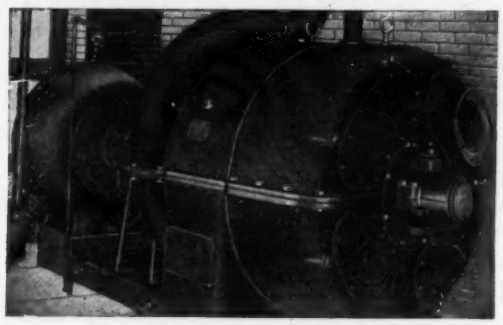
For use on large systems the regulator is supplied with a shunt block, from which the small current required by the relay is obtained. For alternating systems, a series transformer takes the place of the shunt.

The resistance units are connected to a set of copper segments arranged in the arc of a circle on the face of the regulator, and a lever arm carrying the contact shoes, pivoted at the center of the circle, moves over them. The shoes are held firmly to the surface, yet cause but a small amount of friction. A current of one-half an ampere is sufficient to operate a 500-kw regulator. For commercial purposes the regulator is designed to control within one per cent, this being all that is required, although, if necessary, a regulation of one-quarter per cent can be secured, though at some additional expense.

The regulator described is made by the Portland Company, Portland, Me.

Electrically Driven Pumps for Fire Protection.

Automatic sprinkler systems furnished with water from gravity tanks on the roof form a most valuable means of fire protection for large buildings. To keep the roof tanks filled under normal conditions and to enable the automatic sprinklers to continue in operation after the roof tanks have become emptied, during the fire, has usually been accomplished by a steam pump. The advantages of electricity in this work, however, are apparent, and an enclosed electric motor, direct connected to a centrifugal pump, is far superior to a steam equipment for the purpose. In case of fire, the current supply from central station mains entering the building through well insulated underground wires, is far less



ELECTRIC PUMPING EQUIPMENT.

likely to be interrupted by fire or water, than is the supply of steam for running a pump. Moreover, the electrical system does away with the need of a steam boiler with its disadvantages.

A typical electrical equipment for fire protection has recently been installed in one of the largest warehouses in Chicago, built and owned by the Chicago Dock and Canal Company and leased to the Furniture Exhibition Company. The building is constructed of brick, 450 ft. long and 120 ft. deep and rises five stories above the basement, containing about 378,000 sq. ft. of floor space.

The fire protection system comprises 3,360 sprinkler heads with one fireboat connection and twelve fire-steamer connections. A constant pressure is maintained on the system from four 18,000 gal. tanks, one set on top of each fire wall. The tanks are supplied from an electric pumping set which forms the unique feature of the installation. This set, shown in the accompanying illustration, consists of a six-pole, 180-hp, 220-volt General Electric direct-current motor, direct connected to a 6-in. four-stage centrifugal pump. This pumping set has a capacity of 1,000 gal. per minute against a pressure of 150 pounds to the square inch when running at 800 r.p.m. The impellers of the pump are so arranged that artificial means of balancing the end thrust are entirely unnecessary.

Special provisions are made to insure the continuous operation of the motor should it become submerged in water and debris in case of fire. The motor is completely enclosed, the joints in the protecting end plates being ground to make them water-tight. At the commutator end of the machine the motor casing is provided with three hand-holes, each fitted with two glass ports for observing the operation of the machine, while the connection between motor and pump, at the opposite end of the motor, is made through a stuffing box.

Since the protective devices render the motor air-tight, special

arrangements are made for ventilation. Air is drawn into the motor casing from outside the building by a fan on the armature shaft. The inlet opening is shown in the illustration, at the commutator end of the machine. The outlet pipe, seen at the back of the motor, is made in a special involute form in order to establish a steady flow of air through all parts of the motor by keeping the air in motion in the exhaust pipe. With tight piping connections to the outer air, the motor and pump are perfectly watertight and will operate when entirely submerged.

Electric Truck for Central Station Use.

The Cleveland Electric Illuminating Company, of Cleveland, Ohio, has recently installed a large electric truck for handling heavy material such as spools of wire, cables and underground material from its warehouse and from the freight stations to various parts of the city. The vehicle was built by the Elwell-Parker Electric Company, of Cleveland, and was used by that company for about a year for experimental purposes before it was sold to the present owner. The truck weighs 4½ tons and has a carrying capacity of 6 tons. It is fitted with two 3½-hp Elwell-Parker automobile motors which, it is claimed, are capable of giving an overload capacity of 30 hp for brief periods. Current is furnished by a Willard storage battery of 260 amp.-hours capacity, the battery consisting of 40 two-volt cells. On level roads when loaded the vehicle has a radius of about 40 miles with one charge at a speed of 8 miles an hour. The maximum speed, when loaded light, is 10 miles an hour. Under a series of tests the battery has shown a discharge rate of 55 amp. at 80

ELECTRIC TRUCK.

volts, carrying a load of 20,000 lb. at 8 miles an hour on paved streets. The motors are fitted with ball bearings throughout and drives by roller chain to sprockets on the rear wheel. The countershaft is mounted on roller bearings and the wheels also have roller bearings. The wheels are 36 in. in diameter and are fitted with 7-in. solid Hartford tires. The steering gear is of the plain spur gear type and gives double reduction. The vehicle is mounted on a heavy channel iron frame and has a platform 5½ ft. wide by 15 ft. long. The truck has gone up a 10 per cent grade when loaded and in every day service it encounters grades of 6 to 8 per cent, as the company's power station and warehouse is in the low lying section of the city known as the "Flats." The truck has displaced two three-horse teams and it is being used constantly in the important underground work which the company is now installing.

Automatic Ore Unloading at Buffalo, N. Y.

The engravings herewith (Figs. 1 and 2) illustrate the latest installation of the Hulett automatic ore unloader, which is electrically operated and is installed at the docks of the Pennsylvania Railroad, Buffalo, N. Y. As in the case of the other unloaders of this type previously installed, the machine handles an enormous grab bucket with an average capacity for 10 gross tons of iron ore. The spread of the bucket when open is over 18 ft., and by telescopic motion can be extended still farther, thus enabling it to cover a large amount of space in the hold of a boat. It will reach more than half way from the center of one hatch to the center of the other when considering hatches on 24-ft. centers. The bucket is carried on the end of a vertical dependent leg suspended from a walking beam which raises and lowers it as desired,

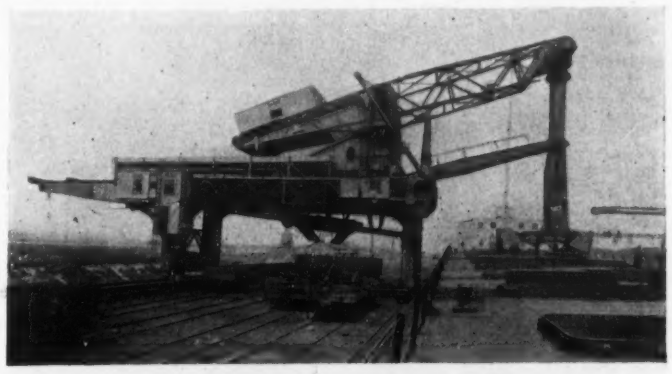


FIG. 1.—BUCKET OPEN.

the bucket leg being mounted on trunnions at the top so that the bucket may rotate when operating in the hold of the boat, allowing it to reach out in any direction. The walking beam is mounted on a trolley or carriage which carries it over the hold of the boat and back again over the dock.

The electrical energy for operating the unloader is furnished by motors which receive their current from sliding contacts. The motor for opening and closing the bucket is 85 hp; for hoisting the walking beam, 150 hp; for trolleying in and out, 50 hp, and for operating the bucket car and moving the machine, 75 hp. The ore may be unloaded into railroad cars on tracks underneath the

FIG. 2.—POSITION OF BUCKET WHEN IN HOLD OF BOAT.

unloader, or may be carried back on the cantilever of the unloader and delivered into a storage pit at the rear of the dock. In either case it is delivered from the bucket into a special "bucket car," or traveling hopper, provided with folding chutes for discharging the material into cars or storage pit. This bucket car travels back and forth as required, and on reaching the desired dumping point is automatically discharged. The installation was made by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, who are sole builders of the machine.

Allis-Chalmers Electrical Works.

The view of the main aisle and extensions of the Allis-Chalmers Company's Bullock Works, at Cincinnati, Shop No. 3, reproduced herewith, will serve to indicate to some degree the large amount of work of all kinds which this branch of the company is rushing to completion.

The works have been greatly enlarged and extended within the past year in order to facilitate the rapid increase in demand for space to manufacture electrical generating, transforming and driving apparatus of every type. They cover at the present time a floor space of approximately 7½ acres. Shop No. 3, the interior of which is shown on page 970, is 462 ft. long, the front portion being one story high and 176 ft. wide, while the rear portion is 107 ft. wide and two stories in height.

On the floor are shown generating units from the small standard sizes up to those of 2,000 kw designed for direct coupling to Allis-Chalmers gas engines. The stator frames (No. 6) are for gas engine alternators being built for the Illinois Steel Company and the Carnegie Steel Company. The large machine at the right (No. 5), only partially shown, is the 3,500-kw alternator

VIEW OF SHOP EXTENSION ALLIS-CHALMERS CO.

which was exhibited at St. Louis, driven by the "Big Reliable" engine at the Louisiana Purchase Exposition, and which has been rewound for installation in the Pittsburg Plate Glass Company's plant at Crystal City, Mo.

Nos. 1, 2 and 3 show brush holder and rotor spiders, respectively mounted on machine tools. No. 4 shows a number of rotor spiders for 2,000-kw gas engine alternators stored, waiting for finishing. No. 7 shows the commutator of a 2,500-kw, direct-current engine-type generator undergoing the process of assembling.

A Commercial Type of Automatic Time Switch.

There is a growing demand particularly in electric lighting for an automatic time switch for opening and closing electrical cir-

AUTOMATIC TIME SWITCH.

cuits. The switch shown in the accompanying illustration was designed by the General Electric Company to meet the definite requirements of this class of service, being adapted for both alternating and direct current. It consists of an electrical circuit-breaker operated and controlled by a single clock movement of heavy and rigid design. The parts are mounted compactly in an iron case with two distinct compartments. The upper portion contains the clock protected against dust and moisture, and the lower part holds the circuit-breaker mounted on a porcelain terminal board. Clock and circuit-breaker are operated by the same mainspring. The clock movement is of simple and rugged construction and the lever escapement will withstand hard usage and vibration. Extra long bushings and pivots are provided and the gear teeth and pinions are very heavy.

The circuit-breaker has a number of interesting constructive features. The brushes are built up of spring leaf copper and the outside leaf is provided with an arc burning tip, so that the main contact surface does not become roughened, but presents always a smooth rubbing surface. Clock and circuit-breaker are connected by a simple release mechanism. The clock movement rotates a dial once every twenty-four hours. The dial is graduated in quarter hours, and for convenience in distinguishing night and day one-half of the dial is blackened. At the edge of the dial are two cams which revolve with a dial, and, acting through levers, control the operation of the circuit-breaker.

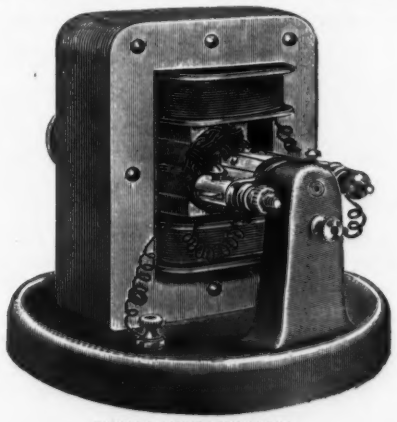
A small lamp within the clock case increases the reliability of the switch when it is exposed to low temperatures. If the time switch is installed in an obscure position the light from the lamp is also of service in examining the apparatus. This time switch is independent of failure of current, being entirely mechanical in action. The principal mechanism is visible when the door is open, and when the door is closed the apparatus is made dust and water tight by a rubber gasket and sealing clamp, which draws the door tightly closed as the handle is turned. The door can then be locked and sealed if necessary. The switch is rated at 25 amp. and 250 volts.

Miniature Dynamo.

Among the numerous novelties brought out for the Christmas trade is a very neat and useful dynamo and motor which has a number of new features. All the small machines in the past have been wound with a single winding, either shunt or series; this one, however, has compound winding connected in such a way that it can be used as a series, shunt, or compound machine by merely connecting the line wires to the correct binding posts, thus making really three machines in one and showing all their characteristics. By using the compound winding when running it as a dynamo, the voltage will remain steady. The field cores are of wrought iron stampings.

The brushes are mounted on a rocking brush holder and can be shifted at will showing the position of sparklessness and the effect of moving either way. The commutator is large in proportion to the machine, and the windings generous.

Owing to the peculiar construction of this machine, the bearings cannot possibly get out of line and the air gap is very small. It can be taken apart or assembled in less than one minute by simply removing two screws in the base, and no matter how often



MINIATURE DYNAMO.

this is done there is no danger of the parts getting out of line.

The machine is very large for its class, weighing 7 lbs., but it can be run from one cell of dry battery; when used as a dynamo, it will give from 25 to 40 watts; 80 watts have been taken from it for a limited time, although it is rated at 25 watts. It is manufactured and sold by E. Q. Williams, 538 S. Clinton St., Syracuse, N. Y.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The features of the week's reports of trade were advances in wages of railway employees, improved collections, good business on spring account, continued scarcity of labor and record-breaking outputs of iron and steel. The results of the elections also established greater confidence in the general situation. The weather conditions were generally favorable and retail trade was active, re-order business from jobbers being larger than usual, while wholesalers reported heavy orders booked for spring delivery. Many industries are severely handicapped by traffic delays, raw materials and fuels coming to the factories in a most unsatisfactory manner. In other cases there is idle machinery because workmen cannot be secured, despite the high wages offered. One of the industries that is likely to be affected by a like cause is that of lumber cutting. Manufacturing returns show unequalled prosperity in the iron and steel industry. Prices for pig iron continue to advance, the increases ranging from 25c. to $2 a ton. Prompt business is made up almost entirely of foreign brands. Furnaces are looking forward to most serious difficulties when once the railroads feel the handicap of the usual trouble in winter transportation. There is little or no prospect of furnaces catching up with their belated orders in the near future. Shortage of labor in all quarters is being felt acutely and is a serious bar to increase in output of both pig iron and coke. In finished lines orders are large except for structural steel. Plates and shapes for shipbuilding and railway bridge material are in good demand. Large orders for steel cars are on the market and locomotives are being ordered freely. Railway earnings for the month of October were 9.8 per cent larger than the same month last year. During the month of October staple prices made another remarkable advance, 47 out of 107 products being marked up. The foreign commerce at the port of New York during the week showed gains of $1,239,417 in exports and $1,868,845 in imports, as compared with 1905. Advices as to collections are more uniformly good than at any previous time this season. Copper again advanced, Lake being quoted at 22½c. on very heavy sales for delivery next year. This is the record price and is said to be guaranteed against a decline. *Bradstreet's* reports 146 business failures during the week ending November 8, against 163 in the previous week and 166 in the corresponding week last year.

PORFIRIO DIAZ TUNNEL.—The Mexican Engineering & Construction Company has the contract and is now pushing the work on the Porfirio Diaz Tunnel in Guanajuato. This tunnel, which will measure 7 meters wide by 7 meters high, is to pass under the city and will, when completed, receive the flood waters from the valleys above the city, thereby preventing any repetition of the recent catastrophe, the tunnel being large enough to prevent any possibility of a like occurrence. The order for the machinery was given to G. & O. Braniff & Co., who as agents of the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., have supplied that make of electrical apparatus, which at present is being so universally used in the various Guanajuato mines. Ten air drills receiving air from two motor-driven Ingersoll air compressors are to be used. The compressors are each 18¼ by 12¼ by 12 in., and the motors will each be of 50 hp capacity. Two motor-driven exhaust fans are to keep the tunnel ventilated as work progresses. A 30-hp electrically-operated hoist will be used to haul the loaded cars out of the tunnel on an incline to the dumping ground at the upper end. To perform the work in the least possible time tunneling will be at both ends. At the lower tunnel end the loaded cars will run out by gravity to the dump. The electric power will be taken from the circuits of the Guanajuato Power & Electric Company, and it is believed that with such a complete and thoroughly modern electrical installation only the best results can be expected.

WORK IN MEXICO.—The Negociacion Minera "Santa Maria de la Paz y Anexas," of Matehuala, have ordered of G. & O. Braniff & Co., agents for Mexico of the Westinghouse Electric & Mfg. Co. and the Westinghouse Machine Co., both of Pittsburg, Pa., an ideal steam-driven electric plant to be installed at their mines. This plant is of a particularly new and interesting nature. The electric power will be used to drive a multi-stage centrifugal pump built by the Brown Jackson Machine Works, of San Francisco. This one pump will deliver 150 gallons per minute against a total static head of 1,640 ft. It is safe to say that this is the greatest head against which a single centrifugal has ever been operated in Mexico, and indicates the rapid advancement which is taking place in this type of pump manufacture, which is proving so well adapted to mining work. This pump is driven by and direct-coupled to a Westinghouse 150-hp alternating-current motor making 1,700 revolutions. The generating plant consists of a Westinghouse compound 16 by 27 x 16 steam engine, which drives a 140-kw, three-phase, 440-volt, 60-cycle generator.

MINING IN MICHOACAN.—The Cia. Metalurgica de Michoacan, Mexico, S. A., of Ocampo, Mich., is installing a complete electrical plant comprising apparatus from the works of the Westinghouse Electric & Manufacturing Company. The previous electrical installation is being augmented by a steam-driven, 45-kw, 250-volt, direct-current generator, which supplies power to the various motors and lamps about the smelter. This generator is of a special construction now often used with similar plants where lamps and motors are to be operated from the same direct-current generator. A special three-wire arrangement is applied, which renders it possible to obtain 250 volts and 125 volts from the one generator. The motors, lightning protection and switchboard apparatus make the equipment complete, and very economical results will be obtained over what would have been possible from a steam plant driving a single line shaft, the former practice with the older plants throughout the republic.

PRICES OF APPARATUS.—We have received the following announcement from the General Electric Company: "Prices in the electrical trade continue to show a distinct upward tendency in sympathy with the well maintained advance which has taken place in the prices of all raw materials. Orders for future delivery can only be placed in many instances at a considerable advance over present market quotations. The General Electric Company, in common with many other large manufacturing concerns, is announcing a general advance in prices of electrical apparatus and supplies. This will not unlikely be followed by further advances if present market conditions continue."

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., has shipped the first carload of electrical machinery for the new plant of the J. W. Sefton Manufacturing Company, of Chicago, located at Thirty-fifth Street and the Chicago River. This shipment covers a 75-kw, 125-volt, engine-type generator and five large motors of the well-known Triumph steel-frame type. Another large generator is to be shipped to the Sefton Company later in the month.

WIRELESS FOR FISHING BOATS.—The Fisheries Company, operating the menhaden fishery industry on the Atlantic seaboard, has arranged to equip with wireless telegraph its steam yacht *Mindora*, and fishing steamships *Walter Adams, Alaska, J. L. Lawrence, Joseph Wharton* and *Arizona*, to keep in touch with the movement of fishing boats along the coast. The De Forest system will be used.

PLANT FOR PLANING MILL.—The Bailey Manufacturing Company, of Waycross, Ga., has bought from the Westinghouse Electric & Manufacturing Company a 310-kw, three-phase, 60-cycle, 440-volt alternator, with switchboard and several motors, for the operation of their planing mill. Mr. C. W. Sexton is the electrical engineer of the plant.

ELECTRIC STORAGE BATTERY.—The sales department of the Electric Storage Battery Company held its annual convention at the Bellevue-Stratford Hotel, Philadelphia, October 24, 25 and 26. The convention was attended by the managers of the sales offices of the company throughout the United States, the district engineers and other officers of the company.

CARBONE ARC LAMP.—Mr. Felix Hamburger, of 78 Fifth Avenue, New York, has secured the agency in this country for the Carbone direct-current "Radiant" arc lamp, which lamp has recently been attracting wide attention in Europe. The lamp in operation may be inspected in Mr. Hamburger's testing laboratory at the above address.

THE STANLEY DISSOLVES.—It is now understood that the Stanley Electric Manufacturing Company is to be dissolved as a corporation and merged entirely into the General Electric Company. The manufacturing plant will, however, be continued.

EXPORT TELEPHONE TRADE.—That the telephone companies and buyers of many foreign countries are beginning to look to the telephone manufacturers of this country for their equipment to remodel and extend their plants is indicated by the rapidly increasing export trade of the International Telephone Manufacturing Company, of Chicago. Among this company's recent shipments were orders of apparatus for the public service systems of the municipality of Neepawa, Man.; the St. Catherine and St. Basile Telephone companies, of St. Catherine and St. Basile, Quebec.; the Compania Telefonica Do Estado de Sao Paulo, Sao Paulo, Brazil; Rosalia Telephone Company, Rosalia, Mexico; the Athens E. L. & T. Co., Athens, Greece. This company also has ready for shipment a 4,800-line capacity, 1,200 installed, central energy lamp signal multiple switchboard equipment, with additional telephones, for the municipal public service system at Port Arthur, Ont., and a similar equipment for Fort William, Ont., and a 500-line equipment for West Fort, Ont.

OAXACA SMELTER PLANT.—Through G. & O. Braniff & Co., Mexican agents for the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., a large and very modern electrical plant for lighting and power is being installed by the Oaxaca Smelting & Refining Company, of which Mr. O. F. Westlund is manager. There is hardly a smelter in the republic which has not its electrical installation. The advantages resulting from the greater economy and efficiency with an electrically-equipped smelter being fully appreciated by this company, they are installing a 110-kw alternating-current generator, 440 volts, 60 cycles, steam engine-driven, with exciter, switchboards, etc., at the generator station. Transformers will be used to supply the arc and incandescent lighting, the many motors up to 50 hp capacity being operated direct from the generator. The motor-driven centrifugal pumps are of the Byron Jackson make, and the triplex are made by the Allentown company.

Financial Intelligence.

THE WEEK IN WALL STREET.—The new high rates for money counteracted the development of bullish tendencies in speculation as a result of the election. It might be claimed that the continuance of record-making railroad traffic and earnings, the comparatively high prices obtained for the year's crops and the sustained prosperity which prevails in business all over the country, are sufficient to create an underlying bullish sentiment. For the moment, however, the market is apparently at a dead-lock, and last week's price movements were unimportant, tending on the whole to gravitate toward the lower level. The traction and local franchise stocks responded feebly to the outcome of the election in New York, and Union Pacific, with Southern Pacific, were manipulated somewhat on the apparent success of the Harriman party in securing control of Illinois Central. Reading also had some temporary support, but it and other standard stocks were, on the whole, rather neglected. At the close of the week the market was irregular, and a further rise in call loan rates, resulting in quotations as high as 16 per cent, tended to create further depressions in spite of the support extended to some portions of the list. Allis-Chalmers, both common and preferred, advanced fractionally, the former closing at 16⅞ and the latter at 45½. General Electric remains unchanged at 175, while Westinghouse made a gain of 3½ points, closing at 158. American Locomotive common closed at 72¾ ex-div. and preferred at 110⅞, both of these quotations being slight declines on the week's business. American Telephone & Telegraph is up 1⅜ points, the closing quotation being 138½ and Western Union declined a fraction, closing at 85¾. Brooklyn Rapid Transit was weak on small trading and closed at 78⅛, this being a net loss of 2⅝. Interborough-Metropolitan, both issues, also declined, common closing at 36⅞ and preferred at 76¾. Trading in outside securities as a whole was without feature, the volume being light. The above table gives the closing quotations of November 13.

NEW YORK

	Nov. 6	Nov. 13		Nov. 6	Nov. 13
Allis-Chalmers Co.	16¾	16⅞	General Electric	176	174
Allis-Chalmers Co. pfd.	44¾	44½	Hudson River Tel	...	...
American Dist. Tel	...	25	Interborough Rap. Tran	...	...
American Locomotive	74⅛	72¾	Mackay Cos.	...	71⅜
American Locomotive pfd.	112¾	111	Mackay Cos. pfd.	69	69
American Tel. & Cable	...	85	Marconi Tel	...	...
American Tel & Tel.	138	...	Metropolitan St. Ry.	..	...
Brooklyn Rapid Transit	81⅛	76⅝	N. Y. & N. J. Tel.	...	...
Electric Boat	...	16	Western Union Tel.	86	85¼
Electric Boat pfd.	...	55	Westinghouse com.	159	155
Electric Vehicle	...	12	Westinghouse pfd.	...	...
Electric Vehicle pfd	...	18			

BOSTON

	Nov. 6	Nov. 13		Nov. 6	Nov. 13
American Tel & Tel.	138½	138	Mass. Elec. Ry. pfd	67½	69
Cumberland Telephone	...	...	Mexican Telephone	3⅝	3½
Edison Elec. Illum.	...	...	New England Telephone	129	...
General Electric	175	...	Western Tel. & Tel.	...	9
Mass. Elec. Ry.	...	18¾	Western Tel. & Tel. pfd.	80	...

PHILADELPHIA

	Nov. 6	Nov. 13		Nov. 6	Nov. 13
American Railways	52	51¾	Phila. Electric	8⅝	8⅝
Elec. Co. of America	11¾	11⅞	Phila. Rapid Trans	27⅛	25
Elec. Storage Battery	70¼	71	Phila. Traction	97⅜	97¼
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Nov. 6	Nov. 13		Nov. 6	Nov. 13
Chicago City Ry.	...	150	National Carbon	...	85
Chicago Edison	...	145	National Carbon pfd.	...	...
Chicago Subway	...	...	Union Traction	4⅛	...
Chicago Tel. Co.	118	...	Union Traction pfd.	...	...
Metropolitan Elev com.	...	25			

UTAH LIGHT & RAILWAYS.—It is stated that control of the Utah Light & Railway Company has passed to F. H. Harriman and associates. The company, which was incorporated under the laws of Utah in January, 1904, is a consolidation of the Utah Light & Power Company and the Consolidated Railway & Power Company, of Salt Lake City. Joseph F. Smith, president of the Mormon Church, is its president. The Utah Light & Railway Company, which controls the entire electric lighting business and most of the street railways of Salt Lake City, is itself controlled by the Gas, Water & General Investment Company, Limited, of London. It has an authorized capital of $4,000,000 non-cumulative preferred and $6,000,000 common stock. Three-fifths of the stock, it is now announced, has been purchased by the Harriman interests, and will probably be turned over to the Oregon Short Line Railway Company, which is usually employed as the holding company for stocks acquired in the interest of the Union Pacific system. Four officers of the Oregon Short Line, W. H. Bancroft, vice-president and general manager; E. Buckingham, general superintendent; P. L. Williams, general attorney, and D. E. Burley, general passenger and ticket agent, have been elected to the directorate of the Utah Light & Railway Company. In August, 1905, the mayor of Salt Lake City signed an ordinance passed by the City Council granting to the company a franchise consolidating all of the franchises theretofore held by it, street railway, gas and electric lighting, and giving the company the right to use the streets of Salt Lake City for fifty years from July 1, 1905. The consideration for this new franchise was the cession to the city of certain water rights owned by the Utah Light & Railway Company.

NEW YORK TROLLEYS.—The statement of the Interborough-Metropolitan Company for the quarter ended September 30 shows some improvement over the corresponding period last year, but there is still a large deficit in the combined statement of the Interborough Rapid Transit Company and the New York City Railway Company. The gross earnings from operation for the three months amounted to $10,247,805, an increase of $640,800 over the same months in 1905. The net earnings and the income from other sources than operation amounted together to $5,545,281, an increase of $651,024. Deducting from this taxes, excluding the special franchise tax, which is in litigation, interest and rentals, including the dividend on Metropolitan Street Railway stock, the dividend on Interborough Rapid Transit stock and the dividend on the preferred stock of the Interborough-Metropolitan Company, there is shown a deficit of $317,638. This compares with a deficit of $783,023 for the corresponding three months of the previous year. In the statement of the New York City Railway itself, there is shown a small surplus for the quarter, against a deficit of $192,842 for the same quarter in 1905. This year, after meeting all charges except the franchise tax and after providing for the 7 per cent on Metropolitan Street Railway stock, there was shown a balance of income of $17,874. It appears that the bulk of the $640,800 total increase in earnings reported by the Interborough-Metropolitan Company represented gains made by the Subway and elevated lines. The gross earnings of the surface lines for the three months showed an increase of only $53,876 over 1905.

TELEPHONY IN CHICAGO.—Mr. M. W. Littleton, of New York, counsel for the independent telephone interests that have bought the Chicago Tunnel Company's franchise, has stated to the corporation counsel of Chicago that the company is prepared to invest from $18,000,000 to $20,000,000 in developing the automatic plant, and that $2,000,000 has already been subscribed to begin operations. He said the company expects to serve 100,000 telephone subscribers as soon as the extensions and installations can be made. The Eastern attorney conferred with Corporation Counsel Lewis and Special Counsel S. S. Gregory for several hours, and gave out the following statement: "A group of

financial and telephone men, embracing the largest builders of independent telephones in the Middle West and the strongest financial connections in New York, have formed a syndicate for the purpose of taking over the telephone franchise and telephone property of the Illinois Tunnel Company. The syndicate has actually underwritten and put in $2,000,000, which is to be spent at once solely on the development, extension and equipment of the telephone business so leased. It has provided for further calls to be made from time to time for the purpose of pushing the telephone development as rapidly as the work can be done. The underwriting provides at present for $10,000,000, and the $2,000,000 already put up is to provide means for immediate expansion."

TRI-CITY GROWTH.—Considerable activity is noted in the stock of the Tri-City Railway & Light Company, the merger of all the street railway, gas and electric companies of Moline and Rock Island, Ill., and Davenport, Iowa. The preferred stock represents an actual cash investment in the properties over and above the bonded indebtedness, and under the terms of the sinking fund provision of the bonds, $2,250,000 of the issue will be retired arbitrarily before their maturity at the rate of $50,000 annually for five years from January 1, 1908; $150,000 annually for the succeeding five years, and $250,000 annually for the remaining five years, thus increasing the equity of this issue. Earnings of the combined companies for the year ended December 31, 1905, under competitive conditions and without the benefits of consolidation and consequent reduction in operating expenses, showed a substantial balance after providing for fixed charges, and the preferred stock dividend requirement under the present plan of capitalization. Under the merger the net earnings for the six months have shown an increase of 22 per cent, while the gross earnings have increased about 13 per cent. The big gain in net is due largely to economies of operation made possible by the unification of the management.

WORCESTER TROLLEY SYSTEM.—The stockholders of the Worcester (Mass.) Railways & Investment Company, through Mackay & Company, are being offered an opportunity to exchange their stock for the preferred stock of the New England Investment & Security Company on the basis of twenty-one shares of the new stock for twenty shares of the old. The New England Investment & Security Company is the company organized a short time ago by New York, New Haven & Hartford interests to take over the street railway holdings of the New Haven road, which had previously been merged under the title of the Consolidated Railway Company. The dividends of the New England Investment & Security Company are guaranteed by the Colsolidated Railway Company, and this guarantee is fully protected by an agreement with the New Haven road, which practically guarantees the dividend on the preferred stock of the New England Investment & Security Company. The holders of Worcester Railway & Investment Company stock are expected under the terms of this offer to deposit their stock with the Old Colony Company, of Boston, as soon as possible, but in any event not later than December 1, 1906.

HUDSON VALLEY TROLLEYS.—Mr. Charles W. Morse, it is stated, has taken over the Hudson Valley Railway Company securities held by E. Clarence Jones, who, with Mr. Morse, held a majority of the convertible bonds of the company. A majority of the stock of this road was purchased some time ago by a syndicate of Troy bankers, who were acting, it was said, in behalf of the Delaware & Hudson Company, which was said to be desirous of obtaining control of the Hudson Valley Company. Messrs. Jones and Morse state that despite the purchase of stock by the Troy syndicate, control of the road rested actually with them through the control of the bonds. Now Mr. Morse becomes the dominant factor in this situation by his purchase of Mr. Jones's holdings. It is reported that Mr. Morse's purchase was prompted by a wish to strengthen his position in negotiating with the Delaware & Hudson Company. The Hudson Valley Railway is regarded as a valuable feeder for the Hudson Navigation Company's lines, which are controlled by Mr. Morse.

NEW MILFORD POWER.—A second mortgage of $2,000,000 has been authorized on the New Milford (Conn.) Power Company, of which $1,000,000 is to retire a similar first mortgage at maturity. It is secured by a first lien on a valuable water power plant on Housatonic River, which has been in successful operation for about three years, under a Connecticut charter. Land on both sides of the river for about ten miles is owned by the company and is covered by the mortgage. The production of power at the original plant is about 10,000 hp. A second plant with 6,000-hp capacity is in process of erection and nearly completed. The new plant is covered by the first mortgage, which also covers transmission lines to Waterbury, New Britain, etc., supplying these cities with power for lamps, street railways and manufacturing. Titles and legality of bond issue have been approved by Messrs. Gross, Hyde and Shipman, Hartford, and Messrs. Guthrie, Cravath and Henderson, of New York. Price 105 and interest.

WESTERN ELECTRIC BUSINESS.—It is stated that the gross sales of the Western Electric Company for 1906 will amount in round figures to $70,000,000. Last year the gross sales of the Western Electric Company were $44,145,753. Ten years ago the gross business of the company was only $8,775,368. This is an eight-fold increase in ten years, a record probably without parallel in any line of electrical business. The increase of $61,000,000 in ten years is equivalent to a gain of 762 per cent. The company was formed in 1881 and the first year for which sales for a full year were published was in 1884. The gross business booked for that year was $1,534,784. The remarkable thing about the Western Electric Company is the tremendous volume of business it is doing on its capitalization. With $15,000,000 of stock issued it is obliged to turn its capital over 4⅔ times yearly to handle a business of $70,000,000. The capital will soon be increased to take care of such an enormous business.

UNITED GAS IMPROVEMENT.—It is stated from Philadelphia that the United Gas Improvement's lease of Connecticut Railway & Lighting, which is practically concluded, is estimated to be worth $15,000,000 to the gas company in cash and in the conversion of latent investments into dividend payers. The actual cash involved is about $7,000,000 and the cash and equities of the transaction are estimated to be equivalent to an increase in value of about $12 per share on the stock of the U. G. I. Co. Among the investments which will be turned into cash through the deal are about $6,000,000 in notes and $1,000,000 in bonds, and the income of the U. G. I. Co. will be augmented to the extent of $600,000 per year.

TELEPHONE CONSOLIDATION IN OHIO.—The United States Telephone Company has acquired nine of the largest independent telephone companies in Ohio. The exchanges are the Columbiana County Telephone Company, the Findlay Home Telephone Company, the Citizens' Telephone & Message Telephone Company of Fostoria, the Lancaster Home Telephone Company, the Massillon Telephone Company, Stark County Telephone Company, Mansfield Home Telephone Company, Youngstown Telephone Company and the Zanesville Telephone Company. The deal involves an exchange of $1,461,800 of United States Telephone Company's stock for the securities of the other companies.

DIVIDENDS.—The transfer books of the American Telegraph & Cable Company will close on November 15 for the payment of a regular quarterly dividend of 1¾ per cent December 1. Niles-Bement-Pond Company has declared a quarterly dividend of 1½ per cent on the preferred stock. Pratt & Whitney Co. has declared a quarterly dividend of 1½ per cent on the preferred stock. Both are payable November 15. The board of directors of the Rochester Railway & Light Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock of the company, payable December 1. The North American Company has declared a dividend of 1¼ per cent, payable December 1.

DEAL AT SYRACUSE, N. Y.—It is stated that negotiations are under way which may result in the taking over by the United Gas Improvement Company of the Syracuse Lighting Company. This company owns the Electric Light & Power Company, of Syracuse, and the Underground Electric Wire Company, of the same city. In 1902 it acquired a controlling interest in the Syracuse Gas Company, exchanging $1,500,000 of its common stock for an equal number of shares of the gas company. The Syracuse Lighting Company has a capital of $3,000,000 common and $1,000,000 preferred, while its funded debt amounts to $2,165,000.

CINCINNATI BELL.—Directors of the Cincinnati & Suburban Bell Telephone Company voted recently to issue $450,000 of new stock now in the treasury. The stock will be issued to old stockholders on a basis of one share at par $50 for every 10 shares held. The company is planning extensive improvements to its system, some of which are under way.

NILES-BEMENT-POND.—A special meeting of the stockholders of the Niles-Bement-Pond Company will be held on November 20 to take action upon proposed amendment of the charter of the company authorizing an increase of the common stock of the company from $5,000,000 to $3,500,000.

GENERAL NEWS.

Construction News.

CENTREVILLE, ALA.—O. C. Oakley has purchased an interest in the Centreville Light Company's electric plant. The plant will be remodeled and the capacity increased, for which enlargement new machinery has already been ordered.

WOODWARD, ALA.—The Woodward Iron Company has commenced the construction of a large power plant, which, when completed, will furnish power for the furnaces and works of the company. The new plant will have double the capacity of the old. The estimated cost of the improvements will approximate $300,000.

ARGENTA, ARK.—The Town Council has granted a franchise to the Argenta Light & Power Company for a term of 35 years to furnish not less than 60 lamps for the town at $120 per lamp per year.

TEXARKANA, ARK.—The Texarkana Gas & Electric Company has purchased the light plant and street railway system of the Texarkana Light & Traction Company, and will improve the lighting service and extend the street railway lines.

PRESCOTT, ARIZ.—All machinery and equipment for the installing of a complete municipal electric light plant will be ordered at once. A three-phase Westinghouse generator, equipped with exciter and switchboard, will be installed at a cost of $2,324.

COMPTON, CAL.—G. R. Fulton, of Compton, writes that he proposes to construct an electric light plant in that city.

MADERA, CAL.—Fritz Paatsch has petitioned for water rights on San Joaquin River, to be used for electrical purposes.

RIVERSIDE, CAL.—The telephone and telegraph companies will be requested to place their wires underground in the business part of the city.

PASADENA, CAL.—Heman Dyer, city clerk, writes that the contract for furnishing machinery for the municipal electric light plant has been awarded to Chas. C. Moore & Company, of San Francisco, for $36,000.

ELSINORE, CAL.—The Southwestern Home Telephone Company has made application to the Board of Trustees for a 50-year franchise. Sealed bids will be received until Nov. 26 for the said franchise, which will be awarded to the highest bidder. C. P. Carter is city clerk.

RED BLUFF, CAL.—J. A. Whiteside has filed two more water claims, one for 40,000 miners' inches of water in Battle Creek, to be diverted at a point near to where Baldwin Creek empties into Battle Creek, and the other for 15,000 inches of water in North Battle Creek. The water will be used for generating electric power.

LOS ANGELES, CAL.—The National Electric Company has recently installed a gasoline engine at its works at 355 East Second Street. Electric motors have recently been placed in the plants of the Henry Manufacturing Company, Solar Heater Company and also the shop of William Barber.

SAN FRANCISCO, CAL.—Market Street will soon be lighted as far as Valencia Street, and Sutter Street as far as Van Ness Avenue. The United Railroads will furnish the electricity for operating the lamps on both streets. At first temporary poles will be used. As soon as possible, however, the United Railroads expects to erect ornamental poles and permanent lamps.

COLORADO SPRINGS, COL.—Surveys have been completed in Bear Creek Canon by W. P. Epperson, of Colorado City, for the Bear Creek pipe line which is to carry a portion of the waters of Bear Creek from Josephine Falls to the head of North Cheyenne Canon where a power house will be erected.

GREELEY, COL.—The Northern Colorado Power Company has purchased the electric light and power plants in Longmont, Loveland, Berthoud, Fort Collins and Greeley. All of the stockholders of the Greeley plant have sold their interests except William Mayher, who has been its manager for the past ten years. He retains considerable stock and is a director of the new company.

NEW HAVEN, CONN.—The United Illuminating Company has decided to place its wires underground in the business section of the city. The work will involve an expenditure of $500,000.

NORWICH, CONN.—The Lebanon Street Railway Company, which holds a franchise to construct an electric railway from Fitchville to Lebanon, will try to get additional franchise rights from the Legislature before starting building operations. The company will ask for a charter to build from Lebanon to Manchester, thus providing for a through line from Norwich to Hartford. The line will be 26 miles long and the estimated cost of construction is $500,000.

JEWETT CITY, CONN.—Owing to a burned-out armature on one of the generators in the electric light plant the town has been without electric light. One of the engines has been out of commission for two months for repairs, but will soon be ready for operation. The People's Light & Power Company, of Danielsonville, has offered to submit prices on a contract for furnishing electricity from its plant in Danielsonville to the switchboard here in the local plant. The People's Light & Power Company is to run a transmission line to Plainville, to light that village, for which it has a franchise.

WILMINGTON, DEL.—W. J. Peall, Centerville, Md., President Peninsula Electric Construction Company, writes that the proposed electric plant will cost about $25,000, but will be let by private contract.

WILMINGTON, DEL.—The Commercial Light, Heat & Power Company, which recently obtained a franchise in this city, paid to the city treasurer, November 6, $12,500 of the $50,000 which the company agreed to pay for its franchise. The company will soon commence the erection of its plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 27, to furnish 150,640 incandescent lamps at the navy yards at Boston, Mass.; New York, N. Y.; League Island, Pa.; Norfolk, Va.; Mare Island, Cal., and Puget Sound, Wash., in quantities as specified. Applications for proposals should refer to Schedule 255. Proposals will also be received until Dec. 4, to furnish at the navy yards at Mare Island, Cal., and Puget Sound, Wash., and the naval training station, San Francisco, Cal., as follows: Schedule 247—pumps, sheet copper, etc. Schedule 251—electric conductor, motors, etc. Schedule 252—motor and transformers, motor-generator set, motor, carborundum wheels, etc. Applications for proposals should designate the schedules desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

ST. AUGUSTINE, FLA.—Ground has been broken for the new electric railway system to girdle the old city and extend to South Beach. The company recently bought the South Beach railway plant.

CORNELIA, GA.—This town has voted to issue bonds for a water and electric light plant.

VIDALIA, GA.—S. B. Meadows, Mayor, writes that the citizens voted Nov. 6 to issue $25,000 bonds for water works and an electric light plant. J. B. McCrary, Empire Building, Atlanta, is the engineer.

TWIN FALLS, IDAHO.—Preparations are being made for the construction of a power plant at Thousand Springs by the Twin Falls Land & Transportation Company, Ltd., of Boise, of which A. M. Harris is president. It is stated that 10,000 hp can be developed. The electricity will be used principally for the operation of the mines in which the company is interested south of the springs.

WALLACE, IDAHO.—The Idaho Northern Railroad Company is to build and operate about 76 miles of road in the Coeur d'Alene mining district. The first installment of the road will be from Kingston up into the Murray District. The road will operate first by steam and later by electric power furnished by the Big Bend Power Company. The officers are B. F. O'Neil, of Wallace, president; E. P. Spalding, of Wallace, vice-president and general manager; F. F. Johnson, of Wallace, treasurer, and John C. Feehan, of Murray, secretary.

CHAMPAIGN, ILL.—The Home Telephone Company has increased its capital stock from $100,000 to $200,000.

SOUTH BEND, IND.—Plans are being prepared by the Northern Indiana Railway Company for the erection of a large power plant in this city.

NEW CASTLE, IND.—Messrs. Pulse & Porter, of Greensburg, have secured the contract for the construction of the power plant of the Indianapolis, New Castle & Toledo Electric Railway.

FORT WAYNE, IND.—H. W. Becker, clerk of the Board of Public Works, writes that the citizens voted Nov. 6 in favor of a municipal lighting plant. No engineer has been selected as yet.

BLOOMINGTON, IND.—Mr. August Ohm, of Terre Haute, who has secured the contract to build the Monroe County court house in this city, announces that he will sublet all the electric equipment and the installation thereof.

CHICKASHA, I. T.—The Chickasha Gas Company writes that it is proposed to construct an electric light plant here, to cost $40,000. C. E. Ross is the engineer.

DES MOINES, IA.—The Interurban Railway Company, of this city, will build an extension of the Colfax line to Newton, a distance of about 6 miles.

DES MOINES, IA.—J. C. Simpson, Secretary Department of Agriculture, writes that it is proposed to erect an electric light and power station at the fair grounds, to cost about $5,000. G. W. Bissell, of Ames, is the engineer.

BOONE, IA.—The work of grading the line which the Newton & Northwestern Company is constructing between Des Moines and Kelley, under the name of Fort Dodge, Des Moines & Southern Railway Company, has been completed, and the graders are now at work on the branch between Kelley and Ames. It is the hope of the officials that the line will be ready for operation between Des Moines and Boone by Jan. 1. The work of constructing a large power plant at Fraser is well under way. The machinery will be installed early in December. Sub-stations will be erected when needed at several points along the line.

SIOUX CITY, IA.—The property of the Sioux City, Homer & Southern Electric Railway Company has been sold to Joseph A. Foye, of Sioux City. This line was completed from South Sioux City to Dakota City two or three years ago, the grading, track laying and ballasting were all finished, but for some reason no rolling stock was ever purchased and the tracks have been idle since construction. Mr. Foye states that he will have the line ready for operation within sixty days. He has already placed orders for cars, and will probably make arrangements with the Sioux City Traction Company for power to operate the cars. He also states that the line will be extended from Dakota City to Homer just as soon as he can shape the financial affairs of the company to that end.

LIBERAL, KAN.—The Liberal Light & Power Company has decided to construct a power plant.

CHANUTE, KAN.—The contract has been let and work will soon commence on the construction of the first inter-urban railway in Southeastern Kansas, which is to be built by the Southwestern Traction Company, connecting Fort Scott, Chanute and Independence. The road will be 125 miles in length. George N. Lindsay is president of the company.

MURRAY, KY.—An election will soon be held to vote on issuing bonds for water works and an electric light plant.

CARROLLTON, KY.—R. L. Bartlett, city electrician, writes that bids will probably be received about Jan. 1 for dynamo, engine and new boilers for the electric light plant. The cost of improvements will be about $25,000.

FRANKLIN, LA.—John C. Lewis, Mayor, writes that necessary funds to construct the municipal electric light plant will have to be raised by special tax, and the matter will hardly be taken up before January or February. The probable cost is placed at $15,000 to $20,000.

BAR HARBOR, ME.—The city has made a new contract with the Bar Harbor & Union River Power Company for furnishing electricity for lighting the streets and public buildings for a term of ten years.

DEXTER, ME.—N. H. Fay, of the firm of Fay & Scott, has purchased the old electric light station of N. C. Fletcher, of Boston, Mass. It is understood that the new owner will renovate the building and install a generator and other machinery for furnishing electricity for the Fay & Scott machine shops.

PORTLAND, ME.—Arrangements have been completed by the Publishers' Paper Company, which owns the water power at Bonney Eagle, Me., for the development of the water power at that point. The company will apply to the next Legislature for a charter to enable it to deliver electricity into Portland. The officers of the company are: William A. Hall, president; S. B. Adams, treasurer; Millard W. Baldwin, clerk.

BALTIMORE, MD.—The stockholders of the Washington, Baltimore & Annapolis Electric Railway Company have voted to increase the capital stock of the company from $4,000,000 to $5,250,000.

WEBSTER, MASS.—The Webster Electric Company has petitioned the State Board of Gas and Electric Light Commissioners for authority to increase its capital stock by $75,000.

PEABODY, MASS.—The Peabody Light & Power Company has voted to increase its capital stock from $10,000 to $20,000 for the purpose of installing a 12-ton refrigerating machine, a 30-kw alternator, and a high-speed engine, to supplement the present plant. L. J. Osborne is manager.

HOPKINTON, MASS.—At a special town meeting held Nov. 2 the citizens voted to authorize the Selectmen to contract with the Edison Electric Illuminating Company, of Boston, for lighting the streets and furnishing electricity at the pumping station for a period of not more than ten years.

SOUTH BOARDMAN, MICH.—W. C. Blackman writes that he is in the market for a 60-kw, 60-cycle, 2,200-volt generator.

PONTIAC, MICH.—The new company to take over the electric light and power company and the plant of the Holly mills will be formally organized in a few days. C. H. Baird and John Lane will hold a majority of the stock.

SAULT STE. MARIE, MICH.—Bids will be received until Dec. 17 by W. N. Sawyer, General Manager of the Michigan Lake Superior Power Company, at Sault Ste. Marie, Ont., for constructing the reinforcement of the power house of the Michigan-Lake Superior Power Company, at Sault Ste. Marie, Mich. Further information may he had at the office of L. M. Davis, chief engineer, Sault Ste. Marie, Ont., Chas. D. Warren and Clarence M. Brown, joint receivers of the Michigan-Lake Superior Power Company.

EVELETH, MINN.—The Mesaba Telephone Company contemplates the erection of a building for its local telephone exchange and will make other improvements to its system.

GRANBY, MO.—H. Campbell, of Joplin, has secured a franchise for a light, water and ice plant.

ST. LOUIS, MO.—The executive board of the Civic League has decided to take up the municipal lighting plant proposition. A new committee was appointed, with Prof. J. L. Van Ornum, of Washington University, as chairman, to investigate the question, together with the most desirable system of street lighting. The committee was organized because of the agitation for a municipal plant and the fact that the present lighting contract will expire in three years. It will make a study of lighting in other cities.

DILLON, MONT.—The Greater Electric Company is planning to utilize the water of Ryan Canyon to increase the capacity of the plant. An order has been placed for three miles of wire-wound wooden stave piping to bring the water from Ryan Canon to Lovell Springs, where the present plant is located. George R. Metlen is chief engineer.

WYMORE, NEB.—H. T. Clark, of Omaha, has secured a franchise for an electric light plant.

LINDSAY, NEB.—Paul Van Ackeren will install an electric light plant in this town, for which machinery has already been purchased.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company is now considering plans for the construction of a new power plant, to meet the increasing demands for electricity caused by the great increase in traffic in Omaha.

GOLDFIELD, NEV.—George C. Sexsmith, representing the California Development Company, of San Francisco, and Los Angeles, Cal., is investigating the advisability of installing water works and an electric light plant in Goldfield.

FRANKLIN, N. H.—Extensive additions and improvements are being made to the electric lighting plant at Giles Mills. A dam 20 feet in height has been constructed and a new power station erected on the bank of the Pemigewasset River, in which a 300-hp turbine wheel has been installed. It is expected to have the plant in operation soon.

ELIZABETH, N. J.—The citizens voted on Nov. 6 in favor of municipal ownership of a lighting plant.

WOODBURY, N. J.—The citizens voted Nov. 6 to build and operate a municipal gas and electric light plant.

CAMDEN, N. J.—At the election held Nov. 6 the citizens voted in favor of establishing a municipal electric light plant.

NEWARK, N. J.—The Germania Electric Company, of Essex Street, Harrison, has removed its plant to 420-422 Ogden Street, Newark.

TRENTON, N. J.—Commissioner Wright of the Department of Charities and Correction has decided to recommend to the next legislature the installation of a central power house at the State Prison.

BAYONNE, N. J.—The United States Electric Company has informed the Council that it will modify its terms for lighting the streets with electricity for a term of five years. The proposition submitted is to furnish electricity for 250 lamps at $85 per lamp per year for two years and for the three remaining years at $80 per lamp, the minimum number to be 350. By these terms the city will save in five years $33.958. In addition to this the company offers to furnish free the electricity needed to operate the mechanism of the fire department.

GALLUP, N. M.—The plant of the Gallup Electric Light Company will be improved and new machinery installed.

PITTSFORD, N. Y.—The Village Trustees have awarded to the Despatch Heat, Light & Power Company the contract for lighting the village for 5 years at $58.85 per year for each arc lamp. About 20 arc lamps will be used.

TROY, N. Y.—The Forest Park Railway Company is preparing to build its proposed line from Forest Park Cemetery to connect with the United Traction Company lines in this city. E. W. Marvin is president of the United Traction Company.

EAST SYRACUSE, N. Y.—The citizens are considering the question of submitting a proposition at the village election in March for the erection of a municipal lighting plant, to furnish electricity for street lamps and for operating the sewer pumps.

MIDDLEVILLE, N. Y.—David E. Ford, president Middleville Electric Light Company, writes that it is proposed to develop additional water power, install new water turbines, construct a new power house and install new generating equipment with switchboard.

NEW YORK, N. Y.—The application of the United States Automatic Telephone Company for a franchise to construct, maintain, and operate a local telephone system has been denied without prejudice by the Board of Estimate, on the advice of the corporation counsel, as the company is a business and not a transportation corporation. Permission was granted to the company to renew the application when it shall have become properly incorporated.

FAYETTEVILLE, N. C.—Work will soon commence upon the alteration and completion of the large power plant of the Cape Fear Power Company at Buckhorn Falls. Mr. Maxwell, who was one of the receivers until the recent sale, will have charge of the work, which will cost about $200,000. The property was purchased at auction by S. Z. Mitchel, Oct. 4, for M. C. Humstone, representing the bondholders.

LAKEWOOD, OHIO.—The City Council has adopted a resolution providing for the issue of $50,000 bonds to repair the electric light plant.

WEST LODI, OHIO.—O. E. Hippler is installing an independent electric lighting plant in this place. D. J. Calhoun, of Bellevue, has charge of the engineering work.

MT. VERNON, OHIO.—F. W. Hawks, who represents Chicago capitalists, is at the head of a party making surveys for an electric railway starting at Gallipolis, and extending northward to Newark, Gambier, Danville and Mansfield.

CHARDON, OHIO.—A new engine and boiler are being installed in the municipal lighting plant and a number of new lamps are being placed in various portions of the city. The lighting department is pushing the commercial lighting field extensively and this necessitated the increase in power station capacity.

TOLEDO, OHIO.—At a recent meeting of the Board of Education the Toledo Gas, Electric & Heating Company submitted a proposition offering to instal two alternating-current electric motors of 7½ hp for $515, less $285 for the motors now in use, in the Waite and Glenwood schools, and to furnish electricity at four cents per kw-hour.

FREMONT, OHIO.—A. H. Jackson and James Hunt, prominent citizens of this place, have made application for a twenty-five-year franchise for tracks on Front and Tiffin Streets. Messrs. Jackson and Hunt are at the head of a company which proposes to purchase the Fremont Street Railway, now owned by Kerlin Brothers, of Toledo.

DAYTON, OHIO.—The Indiana, Columbus & Eastern Traction Company is planning to abandon the Brookville power station of the old Dayton & Northern, and will probably make it a sub-station. High-tension lines will be strung from Dayton over the Dayton & Northern Division and electricity supplied from the Medway power station.

CLEVELAND, OHIO.—The N. P. & O. Dock Company will erect a new power plant at the Erie docks, Cleveland, at a cost of $110,000. The general contract has been awarded to F. C. Werk, electrical engineer. Mr. Werk has also been awarded the contract for the installation of a power plant in the new bank building of the Cleveland Trust Company in this city.

COLUMBUS, OHIO.—One of the largest generators in the municipal lighting plant in this city was wrecked Nov. 2, as a result of overwork and a second machine is in bad shape. About one-third of the street lights of the city are now being carried by the Public Service Company. The engineer of the plant some time ago warned the city authorities that the plant was carrying too great a load and of late there have been numerous controversies among city officials as to the advisability of increasing the equipment of the plant.

EUGENE, ORE.—The Willamette Valley Traction Company has been granted a franchise by the City Council for an electric railway in this city, to be operated in connection with the proposed Eugene-Springfield road.

DESCHUTES, ORE.—The control of the Deschutes Telephone Company has been purchased by Ohio men. The officers of the new company are W. E. Guerin, president and treasurer; E. B. King, vice-president and assistant secretary; R. D. Wickham, secretary. The lines of the company cover Central Oregon and the system will be extended.

MARSHFIELD, ORE.—Plans have been completed for the acquisition of the electric light plants at North Bend and Marshfield and for the construction of an electric railway between the two cities, by a new company. Louis Simpson, of San Francisco; Henry Hewitt and Seymour H. Bell, of Tacoma, Wash., are interested in the new enterprise. The electric line will be nearly four miles in length. A central power station will be established which will furnish electricity not only for the railway, but for the lighting systems at Marshfield and North Bend.

PENNSBURG, PA.—Henry J. Smith, secretary Borough Council, writes that the citizens voted Nov. 6 to issue $15,000 bonds for an electric light plant.

CONNELLSVILLE, PA.—The West Penn Railway & Light Company has decided to increase the capacity of its power plant, and will install a 2,000-kw Westinghouse-Parsons steam turbo-generator set.

TAMAQUA, PA.—The Philadelphia & Reading Railroad Company has completed plans for an electric light plant to be constructed here, to light its yards and other property, and also furnish electricity to operate the machines in its shops. J. E. Tuck is division superintendent.

LUZERNE, PA.—The Council has authorized a contract for a term of seven years at the rate of $60 per lamp per year for lighting the streets. The borough is now paying for 24 lamps at the rate of $70 and has four lamps free. The Council has decided to use the enclosed arc lamps in place of the open lamps now in use.

GERMAN VALLEY, PA.—It is reported that a stock company will soon be formed to supply electric light in this place, Middle Valley and Chester. It is said that a plant will be built on the property recently bought by John C. Kennedy from the executors of the late John Van Der Vort Stryker, of this place, and that power will be obtained by utilizing the mountain stream that runs on the south side of the farm.

CHESTER, PA.—The Suburban Electric Company, which recently purchased the power plants of the Faraday Heat, Light & Power Company, of Morton; the Lansdowne Electric Light Company and the Citizens' Electric Light & Power Company, of Clifton Heights, has purchased the old Lewis Mill, in Matthew's Hollow, on Darby Creek, Lansdowne. It is said that the new company will remodel the present mill and also erect a new power plant, from which will be generated the electricity which will supply Lansdowne, Yeadon, Morton, Rutledge, Swarthmore, Darby and other boroughs and towns in this county.

MEYERSDALE, PA.—The Meyersdale & Salisbury Street Railway Company is about to complete the construction on its line from Garrett to Salisbury, Pa., running through Meyersdale and Boynton, a distance of 13½ miles, the cost of which will approximate $300,000. The company desires estimates for equipment of four-motor 50-hp direct-current interurban cars, one freight and express car combined, also for the overhead construction of 13½ miles and a power house complete with boilers, steam engines, two generators of 300 kw each, pumps, accumulators, storage batteries, switchboard and all other paraphernalia necessary to such power house. The officers of the company are: Orran W. Kennedy, of Uniontown, president; H. G. Kimick, of Pittsburg, secretary; Judge J. Norman Martin, of New Castle, vice-president. All further information can be obtained from W. W. Staub, of the Pittsburg & Allegheny Valley Company, 612 Keystone Building, Pittsburg, Pa.

CENTRAL FALLS, R. I.—A committee has under consideration the matter of establishing a municipal electric light plant. Nothing definite has yet been done and no engineer has been selected as yet.

CHESTER, S. C.—Col. J. E. Brady, president of the Germania Mutual Savings Association, of Chicago, Ill.; L. L. Reading, and J. D. Westbrook, of Chester, have been granted a franchise to construct an electric street railway here.

RAPID CITY, S. D.—The Rapid River Light, Power & Transit Company has decided to develop the water power of Rapid Creek at a probable cost of $250,000.

CLARKSVILLE, TENN.—At a recent meeting of the City Council an ordinance was passed requiring all wires in the fire district of the city to be placed underground.

MOODY, TEX.—J. B. Earl, of Waco, manager of the Brazos Valley Telephone Company, is establishing an electric light plant, to cost $8,000, and give an all-night service. It is expected to have the plant in operation by Dec. 1.

DALLAS, TEX.—The Stone & Webster syndicate, of Boston, Mass., which owns the three electric street railway systems in Dallas, is endeavoring to get the consent of the City Council to the merger of the properties. The separate companies are known as the Consolidated, the Metropolitan and the Rapid Transit. Guy E. Tripp is in charge of the details of the proposed merger plan. It is stated that if the consolidation is effected important improvements to the amalgamated system will be made.

MOAB, UTAH.—The Blue Mountain Telephone & Electric Company has been organized for the purpose of building a telephone line into Bluff City and Indian Crook.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has made application to the Board of County Commissioners for a franchise granting it the privilege of operating an interurban electric line in various parts of the county for a period of 50 years.

HEBER, UTAH.—Francis M. Lyman, Jr., of Salt Lake City, has applied for 150 second-ft. of water, to be diverted from Provo River, in Wasatch County, to be used for operating an electric lighting plant and machinery at Park City, Heber and Salt Lake. The plant will have a capacity of about 5,000 hp.

SALT LAKE CITY, UTAH.—W. B. Abertson, of Salt Lake, has made application to the State Engineer for water rights to a flow of 40 second-feet from Cottonwood Creek. The diverting work will consist of an earthern demote, which will make a total of 3,500 hp. This will be used in operating machinery and an electric light plant in Salt Lake Valley.

BURLINGTON, VT.—At a meeting of the Board of Aldermen, held Nov. 5, resolutions were passed providing that service for electric arc lamps furnished by the municipal electric light plant, which such service is limited to not later than midnight, shall be $4 per month per lamp; and also appropriating the sum of $5,000 to the use of the electric light commissioners for construction work in extending the service of the electric light department.

NORFOLK, VA.—The Norfolk & Atlantic Terminal Company, which operates an electric railway from this city to the Jamestown Exposition grounds and Pine Beach, a distance of six miles, and a ferry line from the latter point to Newport News, has been purchased by the Norfolk & Portmouth Traction Company. The road will be rehabilitated and put in good condition for the Jamestown Exposition.

SUNNYSIDE, WASH.—R. G. Page and S. J. Harrison have petitioned the Council for a 40-year franchise for an electric railway in this city.

SPOKANE, WASH.—The Inland Power Company has filed riparian rights at Rathdrum, Idaho, securing first rights on the large water power there.

ELLENSBURG, WASH.—The North Kittitas Rural Electric Company has applied to the County Commissiers for a franchise to construct and maintain an electric line for the transmission of electricity along certain county roads in Kittitas County.

SPOKANE, WASH.—The Big Red Apple Railway Company has been incorporated to construct an electric railway in the Wenatchee Valley, west of Spokane, for which L. Rice has prepared a report. The incorporators are: F. Scheble, of Cashmere; H. O. Tibbetts and D. B. Olds, of Wenatchee.

SPOKANE, WASH.—The Washington Power Company is now making surveys for a new transmission line to the Coeur d'Alene mining district. The new line when completed will transmit from 16,000 to 20,000 hp to Coeur d'Alene mines and mills. Work will commence on the line in the spring.

MORGANTOWN, W. VA.—The question of establishing a municipal electric light plant is under consideration.

DELAVAN, WIS.—The plant and holdings of the Delavan Light & Fuel Company has been sold to Harold Almert.

KENOSHA, WIS.—The Chicago, Kenosha, Milwaukee & Lake Geneva Company has made application to the City Council for a 50-year franchise to operate its cars on the streets of Kenosha, and to connect with the interurban roads at the north or south limits of the city.

GREEN BAY, WIS.—Officials of the Green Bay Gas & Electric Company have announced that a reduction in price of electrical energy will be made from 17 cents to 12 cents per kw-hour for lamps and from 17 to 10 cents for power, to take effect about the first of the year.

SARATOGA, WYO.—The plant of the Saratoga Electric Light Company was destroyed by fire on Nov. 1; loss about $8,000.

RAWLINS, WYO.—The Rawlins Electric Light Company is contemplating the reconstruction of its system in this city. A new power house will be built and new machinery and boilers will be installed.

CHILLIWACK, B. C.—The by-law has been carried to give the British Columbia Electric Railway Company the franchise to operate a new Westminster-Chilliwack line.

HOPE, B. C.—George S. Perry has applied for 2,500 miners' inches of water in the Coquitalia River, to supply electricity for lighting this town.

VANCOUVER, B. C.—Dr. A. S. Grant, of Dawson City, Y. T., has been in this city making arrangements in regard to the company in which he is interested, which proposes to spend $1,000,000 on a large electric enterprise in the Yukon.

MEDICINE HAT, CAN.—A number of Eastern capitalists are now in Medicine Hat for the purpose of obtaining a franchise for an electric street railway.

PRINCE ALBERT, CAN.—C. O. Davidson, city treasurer, writes that bids will be received on Nov. 30 for improving the water works and electric light plant.

PRINCE ALBERT, CAN.—C. P. Mitchell, engineer of the Ontario Power Company, Toronto, Ont., has been engaged to report on the possibility of hydro-electric development of the Saskatchewan River here.

SASKATOON, CAN.—The Board of Trade has been furnished with estimates by H. B. Proudfoot, civil engineer, regarding the development of the Saskatchewan River at this point. Mr. Proudfoot states that a 20-foot dam providing for 10,000 hp can be constructed for $250,000 approximately. The board will consult other hydro-electric engineers.

WINNIPEG, MAN.—The Canadian Coal & Coke Company has decided to spend $2,000,000 for electrical machinery to be used in the development of its coal lands in Western Canada. O. A. Robertson, St. Paul, and F. E. Kenaston, Minneapolis, Minn., are at the head of the company.

CHIHUAHUA, MEX.—The Parral Power and Reduction Company proposes building hydro-electric plants on a tract of land over the Chihuahua State line in Durango and transmit electricity to operate dredging plants to be established in the Parral district.

CITY OF MEXICO, MEX.—G. & O. Braniff & Company are supplying generators, motors, transformers and other electrical apparatus made by the Westinghouse Electric Manufacturing Company to Branchi & Company, for the Sierra Juarez Exploitation Company. This company owns and will develop its water power and transmit electricity to the Manchya and Purisima mines.

GRAND FALLS, N. B.—The Grand Falls Power Company, Ltd., has decided to construct a transmission line from Grand Falls to Fredickton and St. John, a distance of about 165 miles. It is proposed to develop 10,000 hp.

OTTAWA, ONT.—The Jordan Light, Heat & Power Company and the Lake Erie & Ontario Development Company will apply to parliament for an Act confirming their agreement to amalgamate under the name of the Jordan-Erie Power Company. They will seek authority to take water direct from Lake Erie, as well as through the Niagara and Welland rivers, and for this purpose wish to construct a canal through the townships of Wainfleet, Pelham, Gainesborough, Louth and Clinton, and to dredge the south branch of the Welland River.

Company Elections.

RIDGEFIELD, CONN.—At a meeting of the board of directors of the Ridgefield Electric Light Company, held Nov. 3, Jonathan Bulkley was elected a director. The board now comprises H. B. Anderson, Jonathan Bulkley, J. A. Mitchell, George P. Ingersoll, R. W. Lowe, A. H. Wiggin, and H. P. Bissell.

ROANOKE, N. C.—At the annual meeting of the stockholders of the Roanoke Rapids Power Company held recently W. M. Habliston, of Richmond, Va., was elected president and Winthrop Chauber, treasurer. The directors at the meeting ordered the construction of a dam across the river and the installation of a hydro-electric plant to develop 10,000 hp, to be completed within six months.

New Industrial Companies.

THE ROSS STEAM SPECIALTY COMPANY has been incorporated in New York City with a capital of $30,000 to do mechanical and electrical engineering. The directors are H. N. Dougherty and A. H. Stern, of Brooklyn, and W. H. T. Gerdes, of New York.

THE CANADIAN PRIMELECTRO COMPANY, of Montreal, Que., has been incorporated with a capital of $100,000, to manufacture electrical machinery of all kinds. The charter members include W. Robertson B. L. Nowell, Montreal, and G. G. Roe, Ottawa, Ont.

THE OSCAR C. BROWN & COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000, for the purpose of dealing in electrical machinery. The directors are O. C. Brown, Max Strauss and Herman Herronstadt, of New York, N. Y.

THE THERMO-ELECTRIC LIGHTING COMPANY, of New Haven, Conn., has filed a certificate of incorporation with a capital stock of $10,000, to manufacture and deal in all kinds of electric signs and apparatus and all kinds of hardware specialties. The incorporators are J. V. A. Kimmey, J. V. A. Kimmey, Jr., and Ernest C. Simpson.

THE AMERICAN-PORTUGAL COMPANY, of Jersey City, N. J., has filed articles of incorporation with the Secretary of State with a capital stock of $2,500,000, for the purpose of manufacturing vehicles of all descriptions, engines, machines and all appliances for the generation of power. The incorporators are Julio Maria du Silva Costa de e Vasconcellos Santoa, Benjamin W. J. P. A. Fredericks and Arthur Jackson. W. H. Corbin is named as agent in charge.

Legal.

DUTY OF ELECTRIC COMPANIES TO GUARD AGAINST CROSSING OF WIRES.—Where a telephone company and an electric light company string their wires in such a manner as to render their coming in contact probable each company is under a duty to see to it that the dangerous condition is changed. In such a case, if the wires should cross and an injury result therefrom, both companies are liable. Simmons vs. Shreveport Gas, Electric Light & Power Co., Supreme Court of Louisiana.

AGREEMENT TO LIMIT SHARES OF STOCK ISSUED TO STOCKHOLDERS.—An agreement among several persons contemplating the formation of a corporation, that each stockholder should have issued to him ten shares of stock, and no more, does not contravene public policy and is not void in that it is in restraint of the free transfer and sale of the stock of the corporation. Such an agreement, however, is not binding upon the corporation. The decision is analogous to the cases holding that a by-law of a corporation which clogs the sale and transfer of the stock of the corporation is invalid. Hladovec vs. Paul, Supreme Court of Illinois.

A CORPORATION MAY SUE FOR LIBEL.—Where the manager of the branch office of a corporation wrote a letter to a prospective customer making libellous statements in regard to another corporation, which was its rival in the manufacture of certain machines, the injured corporation may bring action for the libel against it as distinct from a libel against its individual members. To establish the liability of the corporation against which suit is brought the publication must be shown to have been made by its authority, or to have been ratified by it, or to have been made by one of its servants or agents in the scope of his employment and in the course of the business in which he was employed. Pennsylvania Iron Works Company vs. Henry Voght Machine Co., Court of Appeals of Kentucky.

STATUTORY AUTHORITY TO ERECT MUNICIPAL LIGHTING PLANT.—Wisconsin laws of 1901, chap. 95, sec. 1, authorize fourth class cities to purchase, lease or construct public lighting plants. Sec. 2 provides that such power shall be exercised only when ratified by a two-thirds vote at special election. An election was called in the city of Burlington for the purpose of authorizing an issue of bonds for the erection of an electric lighting plant and a majority of the votes cast, but not two-thirds, were in favor thereof. The city authorities thereupon went ahead in the matter of disposing of the bond issue on the theory that prior to 1901 the city had, under other statutes, the authority to establish a lighting plant upon a majority vote and that the restriction in the act of 1901 requiring a two-thirds vote did not apply to such pre-existing authority. It was held, however, that even though the act of 1901 did not confer any new power, sec. 2 thereof had application to any similar power granted in former statutes. The city and its officers were accordingly restrained from contracting for the construction of the plant.

THE NEW ELECTRIC LINES COMPANY VS. COMMISSIONER.—The Appellate Division of the Supreme Court of New York handed down its opinion on November 8th, 1906, in the case of the New York Electric Lines Company vs. William B. Ellison, Commissioner of Water Supply, Gas & Electricity, denying the right of the plaintiff, an independent telephone company, to lay conduits and electric wires under a franchise obtained from the Common Council in 1883. Nothing was done under the authority then granted until December, 1905, when the company made a demand for permits to open the streets for the purpose of installing its wires. Upon the demand being refused mandamus proceedings were begun and the Appellate Division now unanimously denies the motion for a peremtory writ of mandamus compelling the Commissioner to issue the permits. Justie Ingraham, in the course of his opinion, says: "All the elements of a contract are lacking. The relator (telephone company) assumed no obligation whatever in relation to the construction of the subway. All that it agreed to do was that when it built the subway it would comply with the conditions imposed. Until the permission granted was accepted by some act of the corporation under it, I think there was no contract. If the relator had agreed to construct these subways within a specified time a different question would have been presented, but in all the cases where these grants of franchises have been held to be irrevocable it has been because this was an obligation to construct the thing granted or the grantee had acted under its grant and had constructed it."

LIABILITY OF TELEGRAPH COMPANIES FOR DELAY IN DELIVERY OF MESSAGES SENT OVER ITS WIRES.—A telegraph company which, by its delay in delivering a message with reasonable promptness, is the cause of a funeral party not being met upon its arrival by train is responsible in damages to the aggrieved party. The courts of Alabama are committed to the doctrine that the sender of a telegram can recover damages for mental anguish suffered, as the proximate consequence of a failure to deliver a message. In the case of the Western Union Telegraph Co. vs. Long, decided by the Supreme Court of Alabama, although the sendee was not within the degree of kinship so that his absence alone constituted a ground for the allowing of damages for mental anguish, the fact that the plaintiff arrived in the night with the corpse of his child and was not met by his friends, as he would have been if his message had been delivered, was considered a sufficient ground of liability. In a somewhat similar case, decided in North Carolina, it appeared that the

funeral party arrived during the night and in the midst of a heavy rainstorm and that the trainmen, against the plaintiff's objection, placed the coffin out upon the unsheltered platform. It was held that, inasmuch as it was not the duty of a telegraph company to remove the body and place it in a suitable place, the company was not liable for neglect in that regard. The North Carolina cases hold that a telegraph company is only responsible for such damages as were "reasonably in contemplation of the parties as the natural result of the failure of duty on the part of the defendant." In this particular case the Court considered that it could hardly have been within the reasonable contemplation of the parties, at the time the message was sent, that it would be raining upon the arrival of the funeral party. There is a South Carolina statute which provides that damages may be granted for mental anguish caused by "willfully, wantonly, recklessly and negligently" failing to deliver a telegram. Under this statute it has been held that a telegraph company's liability for failing to deliver a message extends only to those for whose benefit the company has knowingly undertaken to transmit the message. The failure to deliver a telegram may cause mental anguish to scores of persons the company never heard of but the company's liability in damages for such mental anguish is limited to those for whom, or in whose behalf, it has agreed to act. Poteet vs. Western Union Telegraph Co., Supreme Court of South Carolina. A telegram, containing an offer to sell grain at a certain price, which was addressed to the plaintiff, was delivered, through the company's fault, to the plaintiff's competitor in business and the plaintiff was thereby compelled to purchase grain in the market at a higher price than that named in the telegram. It was held that the company was liable for the damages entailed and that it was unnecessary for the plaintiff to show that, had the telegram been promptly delivered, he would have accepted the offer made therein. Lathan vs. Western Union Telegraph Co., Supreme Court of South Carolina. The laws of Indiana require telegraph companies to transmit messages in the order of their receipt, and without discrimination, and further provide for a penalty in case of a violation of this requirement. A recent decision declares that the right to recover the penalty prescribed is not limited to cases where the company has been guilty of willful wrongdoing but that an instance of negligent failure to deliver a telegram comes within the contemplation of the statute. Western Union Telegraph Co. vs. Sefrit, Appellate Court of Indiana.

Obituary.

MR. W. H. REYNOLDS.—Colonel William H. Reynolds, well known in financial circles of New York, Paris and London, as a promoter, died at his home in New York, last week, of pneumonia. He was born in Providence, R. I, in 1827 At the outbreak of the civil war he joined the First Rhode Island infantry, of which he became commander, displaying high qualities as a leader At the close of the war he became a cotton broker here. When the Bell Telephone Company determined to introduce its system abroad Colonel Reynolds went as its representative. He spent about a year in England and on the Continent, and formed a large acquaintance during his travels. It was his privilege to demonstrate the telephone and its efficiency to Queen Victoria. The transmitter and receiver that he used on that occasion are carefully preserved by the family. Since 1882 he made his residence in this city, where he became interested in cotton, mining and general promoting. He made frequent trips abroad during succeeding years. Colonel Reyonlds was a member of the Union and Manhattan clubs. He is survived by a son and a daughter.

MR. JOHN L. OBERG, of the firm of Oberg & Blumberg, electrical contractors, New York, died at his home in Ridgefield Park, N. J., on Thursday, November 8th, 1906, from heart disease, in the thirty-ninth year of his age. Mr. Oberg was born in Sweden, 1868, and came to this country in 1886. He was prominently identified with the electrical construction industry for the past 20 years, being a member of the New York Electrical Contractors Association, State and National Associations. In 1886 he entered the employment of Thomson-Houston Electric Company, at Lynn, Mass., and served in various capacities until 1891, when he was in charge of the outside construction department. He then entered the employ of the Tucker Electrical Construction Co., and met with an unfortunate accident in 1893 whereby he lost his right arm. From 1894 to 1898 he was in the employ of the Alexander-Chamberlain Electric Company, as superintendant of construction. On January 31, 1898, the firm of Oberg & Blumberg was organized, since when they have executed large electrical contracts over the entire country. Mr. Oberge was prominent in Republican politics in Bergen County, N. J., where he served several years as chairman of the Village Trustees. He leaves a widow and daughter four years of age. The business of Oberg & Blumberg will be continued as heretofore.

Personal.

MR. JOHN HACKSTAFF has been appointed general superintendent of the Atchison Railway, Light & Power Company, of Atchison, Kan.

MR. H. B. KIRKLAND has accepted the position of assistant general sales manager of the National Metal Molding Company, with headquarters at Pittsburg.

MR. J. W. DUNTLEY, president of the Chicago Pneumatic Tool Co., sailed for Europe, November 6, for a five week's trip in the interest of the company's business, during which time he will visit England Scotland, France and Germany.

MR. G. TRACY ROGERS, president of the Binghamton Street Railway Company and other up-State traction enterprises, has been elected to the directorate of the Long Acre Electric Light and Power Company, recently absorbed by the Manhattan Transit Company.

MR. ALBERT SPIES, who for some years past has been the editor of *Cassiers' Magasine*, has resigned from that position, dating from Nov. 17. Mr. Spies has signalized his editorship by a highly intelligent and successful policy, and his work has won general appreciation and recognition.

MR. MATTHEW M. MERRITT, who has been manager of the Boston Incandescent Lamp Company, of Danvers, Mass., has resigned to prosecute research work. Mr. Merritt is having a special laboratory constructed, and will give his entire attention to experimental work. He will be succeeded by Edward E. Strong.

MR. C. B. FAIRCHILD, JR.—A new technical publication known as the *Electric Traction Weekly*, will be published in Cleveland beginning Nov. 25, by the Kenfield-Fairchild Publishing Co. Mr. Charles B. Fairchild, Jr., formerly associate editor of the *Street Railway Journal*, will be editor, and George S. Davis, formerly Ohio correspondent, associate editor. The paper will be devoted to the practical operating features and news matters of electric railway industry. Cleveland was selected as a publishing point because of the importance of that city as a center for the financing and operation of electric railways.

NEW YORK CENTRAL STAFF.—The following changes in the engineering and construction department of the New York Central have been announced: Edwin B. Katte, electrical engineer, appointed chief engineer of electric traction; George A. Harwood, appointed chief engineer of electric zone improvements, with the exception of electric traction and signals; John D. Kelly, appointed electrical engineer, to succeed Mr. Katte; Carl Schwartz, appointed engineer of power stations; J. L. Holst, appointed engineer of structures, in electric zone, except Grand Central terminal, and design of buildings not in charge of associate architects, and the design of all masonry, miscellaneous structures north of the south bank of the Harlem River; W. F. Jordan, appointed terminal engineer in charge of design and construction of Grand Central terminal and work south of the south bank of the Harlem River, except structural work in charge of associated architects; L. H. Byam, appointed engineer of the forces executing work authorized by principal and assistant engineers. George A. Berry, engineer of company forces in the electric zone, has resigned. W. H. Knowlton has been placed in charge of contract construction work and right-of-way matters from the south bank of the Harlem River to Peekskill and North White Plains.

Trade Publications.

THE DE LA VERGNE MACHINE COMPANY, foot of East 138th Street, New York City, has just issued a folder describing the Klein water cooling tower built by it. These towers will cool the water to from 5 to 15 deg. below the temperature of the atmosphere.

BLUE PROCESS PAPERS AND LINENS.—The Keystone Blue Paper Company, 910 Filbert St., Philadelphia, Pa., is distributing among its patrons and the trade generally a sample book of many varieties of papers and what is stated to be the most varied assortment of ferro-prussiate papers carried by any house in this country.

THE BURT MANUFACTURING COMPANY has just issued a handsomely printed catalogue containing descriptions of its well-known oil filters, exhaust heads, combination skylights and ventilators and its oil filtering system, all of which are carefully described and illustrated. The description of the American oil filtering system is particularly interesting and is well worth any engineer's careful reading. This company has been in the field manufacturing oil filters, etc., for a number of years and enjoys an enviable reputation. The catalogue is one which every engineer should have in his possession, as its contents will give him ideas of economy worth many dollars to him. The catalogue can be had for the asking. The company's offices and works are located at Akron, Ohio.

News of the Trade.

PHOENIX ELECTRIC COMPANY, of Mansfield, O., manufacturer of dynamoelectric machinery, has opened a Chicago office at 83 West Jackson Boulevard, in charge of Mr. John Nangle.

THE INTERSTATE ENGINEERING COMPANY, of Cleveland, Ohio, has increased its capital stock from $500,000 to $1,500,000. The company manufactures electric cranes, hoisting and conveying machinery.

THE AJAX LINE MATERIAL COMPANY, of Chicago, has increased its capital stock from $12,500 to $20,000. The increase is made necessary by the growth of the demand for its goods which now include toggle bolts, mast-arms, arc lamp insulators and bracket fixtures.

THE ANSONIA ELECTRICAL COMPANY, of Ansonia, Conn., manufacturer of insulated wire, is planning to make a large addition to its plant. The new structure will be a four-story brick building, 50 by 80 feet, and will increase the capacity of the plant by more than 50 per cent.

THE MARLBORO ELECTRIC MACHINE & LAMP COMPANY, of Marlboro, Mass., has decided to establish a manufacturing plant in Worcester, and steps have been taken to secure quarters. The company has been pressed for room in its factory for some time, and an order for 50,000 lamps, which must be turned out at once, made it necessary to

have more space. The Marlboro factory, it is said, is now turning out 12,000 lamps a day.

JAEGER LAMPS.—The Jaeger Miniature Lamp Mfg. Company, 134 Bible House, New York City, has just issued a new folder and catalogue of its Christmas outfits for tree and decoration purposes. There are four complete outfit sets, with Santa Claus electric candles, festoons of sockets, and the attaching plug. Such outfits become more popular every year with the public and should be pushed by central stations.

H. W. JOHNS-MANVILLE COMPANY.—Considerable trouble, annoyance and expense are caused in cold weather by the freezing of water pipes, especially where these are openly exposed to the outside air. The H. W. Johns-Manville Company, of 100 William Street, New York, has a covering which is sold under the trade name of "Zero" and which effectively prevents freezing of pipes during cold weather. This covering consists of a combination of hair felt and wool felt, which possesses the highest insulating qualities. For ordinary conditions, one layer of this covering is sufficient, but where pipes are exposed to the weather, two thicknesses should be used.

KEYSTONE LUBRICATING COMPANY, of Twentieth street and Allegheny avenue, Philadelphia, has received recently from the Cramp shipbuilding concern the following report or synopsis of tests on its specialty: "The sample of Keystone Grease No. 1 density submitted by you, has been subjected to a chemical examination as per custom with results as follows: Free fatty acids, 0.14 per cent; free mineral acids, n^{21}; rosin oils, nil; talc, graphite, clay, etc., nil. The above sample of grease was found to be entirely free from all deleterious substances, such as would cause decomposition of the grease, or would have any detrimental effect upon metal surfaces."

THE STANDARD VARNISH WORKS, 29 Broadway, New York, announces that its waterproof "Insulating Black," which has been gotten up especially for use in connection with interior wiring, signal telegraph and telephone work, has been approved by the Underwriters' Laboratories of Chicago, which concern passes on the various electrical appliances and materials used in wiring construction. This material is being used extensively for wiring and construction work and has received the recommendation of prominent engineers and construction concerns on account of its ability to dry quickly and at the same time retain its plastic and water-proofing properties. This material at the same time possesses high insulation, is easy to work and is free from all objectionable odor.

THE CLARK ELECTRIC & MANUFACTURING COMPANY, whose offices are located at 135 Broadway, New York, is increasing its manufacturing facilities at its Brooklyn factory in order to enable it to meet the rapidly increasing demand for its clamps, splicing sleeves. Many of the modern transmission lines constructed within the past year have been equipped with these splicing sleeves and clamping devices. Among them are the lines of the Mexican Light & Power Company, Necaxia & City of Mexico, the Rio de Janeiro Tramway Light & Power Company, Rio de Janeiro, Brazil, Santos Light & Power Company, Santos, Brazil, S. Pierson & Sons' lines, Pueblo & Vera Cruz, Mexico, Guanajuata Power Company, Guanajuata, Mexico, Curtis & Hines transmission lines, Colo.; Northern Power Company's lines at Duluth, Minn.; Winnipeg Electric Railway Company, Winnipeg, Manitoba, Canadian Development Company, Toronto, Canada; Hudson River Power Company, Glens Falls, N. Y.; North Georgia Electric Company, Gainesville, Ga.; Nictheroy transmission lines, Brazil; Sao Paulo transmission lines, Brazil; Edison Electric Company, Los Angeles, Cal.; Southern Power Company, Charlotte, N. C.; Indian Government lines at Kashmir, India, and several new transmission installations in Japan.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 6, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

834,879. MOTOR WHEEL FOR VEHICLES; Warren W. Annable, Grand Rapids, Mich. App. filed July 26, 1905. The vehicle wheel has its rim supported by dished plates instead of spokes, and motors are contained in the cavity thus formed.

834,899. DENTAL HANDPIECE; Wallace W. Freeman, Norfolk, Va. App. filed Aug. 22, 1905. A dentists's drill having a handle with a motor contained therein so as to be in permanent alignment with the spindle.

834,926. VIBRO METER; Edward McGarvey, Youngstown, O. App. filed June 24, 1905. An apparatus designed to permit alternating current generators to be put into step. A rod is forcibly vibrated with the periodicity of the current and the model point is indicated on a dial so as to show the rate of vibration.

834,948. ELECTRICAL FURNACE; Frank J. Tone, Niagara Falls, N. Y. App. filed Sept. 14, 1905. Details of an electric furnace having a base provided with a cooling medium so as to prevent diversion of the current through the base.

834,952. THERMOSTATIC CIRCUIT CLOSER; Charles L. Walker, Harrow, Eng. App. filed Mar. 25, 1904. A U-shaped tube is sealed at both ends and has enlargements therein which are adapted to cause a movement of a mercury column by air expansion in case of a too sudden rise of temperature in the locality where the instrument is installed.

834,953. RHEOSTAT. Orville T. Weiser, Philadelphia, Pa. App. filed Feb. 7, 1906. A sheet metal casing having perforations for ventilation contains transverse rods between which the resistance coils are hung.

834,989. ELECTRIC FUSE; John J. Miley, Boston, Mass. App. filed Mar. 5, 1906. A construction of fuse having long slotted metallic clips at each end which form the connections of the fuse on various different types of switch boards.

834,990. INCANDESCENT ELECTRIC LAMP; George P. McDonnell, St. Louis, Mo. App. filed Sept. 1, 1905. The carbon filament is directly fused into the glass and the platinum connections are attached thereto at a point along the length of the filament.

834,995. ELECTRIC CLOCK; Arthur F. Poole, Wheeling, W. Va. App. filed Dec. 6, 1900. Designed to do away with dash pot and lever systems for slowing up the return movement of the switch, and provides a simple pendulum for such purpose.

835,003. ELECTRIC TERMINAL FIXTURE; Arvid H. Svensson, Buffalo, N. Y. App. filed Jan. 8, 1906. Relates to a canopy support which is detachable, in which the circuit wires are so arranged that they need not be disturbed when it is removed.

835,023. TRANSFORMER; Hermann Heincke, Steglitz, near Berlin, Germany. App. filed Jan. 17, 1905. A transformer for high tension currents for the production of electric waves for wireless telegraphy, therapeutic and other purposes comprising an insulated metallic core, a coil wound round the latter, a source of electricity in connection with the core, and a condenser connected directly with the ends of the coil, substantially as described.

835,025. CIRCUIT PROTECTIVE DEVICE; Dugald C. Jackson, Madison, Wis. App. filed Sept. 24, 1904. Relates to circuit protecting apparatus which introduces resistance in the circuit after a certain interval so as to prevent destructive current flow.

835,037. TELEPHONE REPEATER CIRCUIT AND APPARATUS; Herbert E. Shreeve, Newton, Mass. App. filed Jan. 24, 1906. In a system for the reinforcement of renewal of telephone-currents, the combination with a circuit comprising telephonic current-transmitting sections of different capacity, of a relay apparatus associated with the circuit, and means connected with the circuit for balancing the capacity of its said sections.

835,039. ADJUSTABLE SWITCH BOX; Silas D. Slocum, Alexandria, Va. App. filed Sept. 18, 1905. A switch box made of sheet metal and having adjustable lugs thereon by which the position of the box can be changed.

835,046. TELEPHONE SYSTEM; Alfred Stromberg, Chicago, Ill. App. filed Nov. 24, 1902. Details of a telephone system including the cord and relay circuits.

835,047. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed May 7, 1903. Relates to modifications of the above.

835,052. PROCESS OF PRODUCING MOLYBDENUM AND ITS ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed Feb. 1, 1906. The process of reducing molybdenum which consists in smelting a mixture of molybdenum sulfid and a desulfurizing agent, as set forth.

835,074. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; Julius K. Lux, St. Louis, Mo. App. filed Oct. 11, 1904. Details of construction of a single blow snap switch having springs and cam operated detents to insure the quick operation.

835,082. SELF ELECTRIC MESSAGE APPARATUS; Sven R. E. Schmidt, St. George, N. Y. App. filed Feb. 8, 1905. The massage device has two rollers which are made the terminals of an electric circuit.

835,097. TORPEDO SETTING MECHANISM; Chester L. Chamberlain, Los Angeles, Cal. App. filed Apr. 19, 1906. An automatic feeding device for positioning torpedoes on the track rails in advance of a train.

835,103. DEVICE FOR REVERSING AND AUTOMATICALLY BLOCKING TRAINS ON ELECTRODYNAMIC TRACTION RAILWAYS; Julian Dulait and Leon Rosenfeld, Charleroi, Belgium. App. filed Feb. 8, 1905. Two special trolley conductors are laid between the track rails and are engaged by special depending rollers or shoes from the train.

835,113. INSULATING COMPOUND; Samuel G. Penney, Allegheny, Pa. App. filed June 19, 1906. "The herein-described composition of matter, consisting of maltha, byerite and carbon tetrachlorid."

835,119. TELEPHONE ATTACHMENT; Bradley L. Stone and George M. Dressel, Belpre, O. App. filed Mar. 12, 1906. A form of indicator adapted to be attached to the bell vibrator to indicate when a call has been received in one's absence.

835,138. AUTOMATIC LIGHTING BURNER; Howard Lyon, Oneonta, N. Y. App. filed May 2, 1905. The gas cock has an arm with a contact thereon which closes an ignition circuit for the gas when the cock is turned on.

835,142. INSULATING COMPOSITION; Wilson H. Strickler, Columbus, O. App. filed Feb. 16, 1906. An insulating material formed of comminuted asbestos, comminuted mica, double silicate of soda and a solution of soap.

835,158. TERMINAL TIP FOR ELECTRIC CONDUCTING WIRES; Gustave L. Herz, New York, N. Y. App. filed Aug. 15, 1904. A sheet metal terminal clip stamped to produce a groove in which the bared portion of the wire may be wound and soldered.

835,181. TELEPHONE; Robert A. Davidson, Santa Cruz, Cal. App. filed May 14, 1906. An improvement in telephones comprising a telephone system having a normally open talking-circuit, a receiver-hook to automatically close said circuit when the receiver is removed, and means independent of said hook and operated from the central office for opening said circuit said hook controlling said circuit-opening means to restore the system to normal.

835,183. ELECTRIC BELL; Harold W. Eden, Detroit, Mich. App. filed Dec. 26, 1905. Relates to a compound lever connection between the vibrator and the bell hammer by which the latter has a wide arc of movement.

835,199. ELECTRIC BELL; Charles M. Proctor, Detroit, Mich. App. filed Dec. 26, 1905. Relates solely to a metallic stamping for holding the vibrator contact for an electric bell.

835,211. COUPLING DEVICE; Charles E. Atkinson, Richmond, Ind. App. filed Oct. 20, 1905. The circuit wires are soldered to metallic couplers which became wedged tightly together when strain is applied to the conductors.

835,227. DYNAMO-ELECTRIC MACHINE; Robert Pohl, Bradford, England, and Felix Pohl, Cologne, Germany. App. filed Jan. 28, 1905. In a dynamo-electric machine, the combination with the armature, field-poles and yoke, of intermediate pole-pieces between the main field-poles, said intermediate pole-pieces having their effective faces so shaped as to increase in breadth toward the main poles whose polarity is contrary to that of the respective intermediate poles.

835,229. PLATE FOR SECONDARY BATTERIES; James H. Robertson, New York, N. Y. App. filed Feb. 1, 1904. A plate for secondary batteries having formed in each side thereof registering and oppositely-communicating recesses, each being formed in the arc of a circle, whereby finely-tapering parts are formed between the ends of the recesses and at each side of a central aperture, the bottom surface of each recess being longitudinally grooved.

835,258. PLUG SOCKET FOR ELECTRIC LAMPS, ETC.; Frank J. Russell, New York, N. Y. App. filed Feb. 23, 1906. A molding receptacle having circuit wire connections directly attached to the shell and to the central stud.

835,268. DISTRIBUTING-BOARD; Charles E. White, Chicago, Ill. App. filed Mar. 24, 1906. A distributing-board for electric wires, the line side and the switchboard side of which extend in the same direction and lie in planes at an angle with each other.

835,269. SELECTIVE SYSTEM; William E. Whitehorne, Bethlehem, Pa. App. filed Mar. 15, 1906. A system consisting of a two-conductor line, a source of current, means for connecting said source to either of said conductors and to the ground or to both conductors independently of the ground, a three-way condenser, and connections from the plates of said condenser to the line conductors and ground respectively, substantially as described.

835,278. HANDLE FOR ELECTRIC SNAP SWITCHES; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Nov. 21, 1905. Provides an insulating body with a headed plunger and a spring therein, and a retaining end secured to the outside of the insulating body.

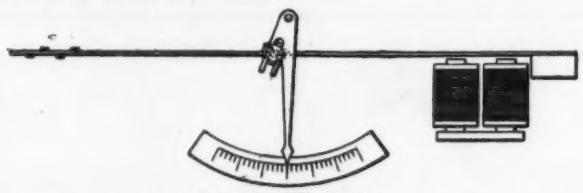
835,282. INCANDESCENT LAMP CLUSTER; Harvey Hubbell, Bridgeport, Conn. App. filed Oct. 15, 1904. An incandescent lamp cluster in which the parts having terminal circuit wire connections are so small as to permit new canopy shades to be positioned without deranging the connections, as often as such shades are broken.

835,307. MANUFACTURE OF CARBON TETRACHLORID; Joseph M. Matthews, Philadelphia, Pa. App. filed Jan. 26, 1904. The process of producing carbon tetrachlorids, which consists in preparing an admixture of calcium chlorid and carbon adapted to react and form calcium carbid and chlorin compounds of carbon, and subjecting the admixture to heat sufficient to effect the reaction indicated, substantially as described.

835,321. ELECTRIC METER; William H. Pratt, Lynn, Mass. App. filed Apr. 20, 1904. Mechanical construction of an alternating current watt-hour meter designed to secure a high torque and proper phase displacement, and in which means are provided for compensating for starting friction.

835,322. ELECTRIC MEASURING INSTRUMENT; William H. Pratt, Lynn, Mass. App. filed May 24, 1904. Provides for obtaining uniformly graduated scale by having specially formed pole faces.

835,329. MEANS FOR PRECIPITATING GOLD AND SILVER; James Snodgrass, Johannesburg, Transvaal. App. filed Jan. 3, 1906. In apparatus for precipitating metals, a cathode comprising a metallic frame, a metallic screen of fine mesh secured to each side of said frame, and a fabric having a conductive coating over said metallic screen; substantially as described.



834,926.—Vibro-meter.

835,344. CURRENT-RECTIFIER; William S. Andrews, Schenectady, N. Y. App. filed Aug. 13, 1904. Means for rectifying three-phase alternating current comprising reactance-coils connected respectively with the three line conductors, said coils meeting at a common point, three electrodes connected respectively with the three line conductors, said coils meeting at a common point, three electrodes connected respectively with the line conductors, an electrolyte in contact with said electrodes, additional electrodes in said electrolyte, and means for connecting said additional electrodes to said common point.

835,353. CUT-OUT; Richard Fleming, Lynn, Mass. App. filed Apr. 30, 1903. A cut-out for high potential circuits is enclosed within a bell-shaped insulator and is protected from rain and moisture.

835,354. SYSTEM OF ELECTRICAL DISTRIBUTION; Richard Fleming, Lynn, Mass. App. filed Oct. 13, 1905. Relates to a system of alternating current distribution including a plurality of mercury vapor rectifiers.

835,361. TELEPHONE-RECEIVER; Charles T. Mason, Sumter, S. C. App. filed Mar. 7, 1906. In a telephone-receiver, in combination, a cup supported in the casing at the front end of the magnet and through which the pole-pieces project, a plate which fits in the bottom of the cup, around the pole-pieces, coils on the pole-pieces in the cup and mounted upon said plate, and screws extending through the end pieces of the coils and the plate into the bottom of the cup.

835,362. OPERATING BULKHEAD DOORS; Wilbur L. Merrill, Schenectady, N. Y. App. filed Jan. 19, 1906. In order to avoid failure of the motor to close a bulkhead door as long as there is any possibility of its acting, the patentee has no fuse or cut-out in the motor circuit, except a centrifugally operated device to open the circuit in case the motor becomes actually stalled.

835,363. CONSTANT CURRENT GENERATOR; Maurice Milch, Schenectady, N. Y. App. filed Apr. 3, 1905. Has commutator brushes arranged on a line disposed substantially 90 deg. from the line of the main field magnetization, auxiliary brushes on the line of the field magnetization, and auxiliary field coils supplied from the auxiliary brushes.

835,367. INSULATION FOR ELECTRIC CIRCUITS AND METHOD OF PRODUCING THE SAME; Harris J. Ryan, Ithaca, N. Y. App. filed Sept. 24, 1903. The combination of a transformer; an air-tight compartment within which said transformer is enclosed; a liquid dielectric in which said transformer is immersed; and means for subjecting said liquid dielectric to a pressure of many atmospheres.

835,381. MEANS FOR CONTROLLING ELECTRIC MOTORS FROM A DISTANT POINT; Frederick A. Willard, Lynn, Mass. App. filed June 7, 1905. Relates to mechanism whereby an electric motor can be caused to move a given device back and forth within a predetermined range of travel in varying amounts and in either direction from any point within said range.

835,382. SYSTEM OF VALVE CONTROL; Frederick A. Willard, Rochester, N. Y. App. filed Feb. 23, 1906. In order that the position of different valves may be indicated they are provided with a device for making a step-by-step current which operates the indicators in the manner of a messenger call.

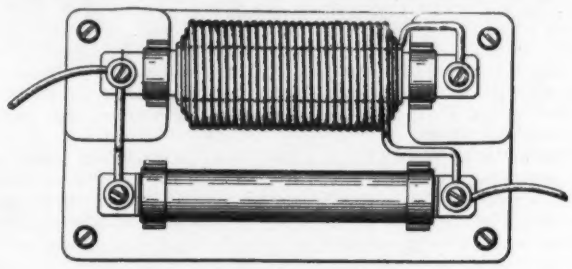
835,384. ELECTRIC SIGNALING SYSTEM; James S. Anderson, Ames, Neb. App. filed June 16, 1906. The locomotive is built with conductors extending longitudinally thereon and which engage depending plates so as to complete a signal circuit to the locomotive cab.

835,388. THERMAL CUT-OUT; Ernst J. Berg, Schenectady, N. Y. App. filed June 1, 1903. A construction of multiple fuse in which the arc is supposed to be taken by a relatively fine high fusible filament in parallel with the main fuse. Patentee introduces an inductive resistance in the auxiliary fuse circuit so that it will not blow simultaneously with the main fuse.

835,401. PROTECTIVE DEVICE FOR AUTOMOBILE MOTORS; Alexander Churchward, Schenectady, N. Y. App. filed June 12, 1905. Designed to permit flow of current through the motor as long as the field winding remains energized, but in case the field circuit is interrupted while in parallel with the resistance, the motor circuit will be broken.

835,406. WIRE CONNECTOR; William F. Dawson, Schenectady, N. Y. App. filed Mar. 13, 1902. A device for joining together sections of telegraph wire. Has a pair of adjacent tubes struck from a single piece of sheet metal into which the wire sections are inserted and braized.

835,407. ALTERNATING-CURRENT MACHINE; Max Deri, Vienna,



835,388.—Thermal Cut-Out.

Austria-Hungary. App. filed Apr. 12, 1905. In an alternating-current dynamo-electric machine, in combination with the stator and the usual winding carried in the stator-slots, a transformer-winding of a different number of poles carried in the same slots.

835,410. SIGNAL; Charles R. Dowler, Lamar, Col. App. filed Jan. 12, 1906. Details of a complete signal system including the construction of the signal box for displaying an alarm signal in case of high water at a bridge. The alarm circuit is closed by a float raised by the water.

835,411. CIRCUIT BREAKING DEVICE; Charles R. Dowler, Lamar. Col. App. filed Feb. 9, 1906. In order to indicate when a portion of the track has been undermined, the patentee has weights buried at intervals which fall to close an alarm circuit when the earth underlying the track is carried away.

835,415. SWITCH; Edgar W. Gough, Great Barrington, Mass. App. filed May 3, 1905. A magnetic cut-out having a form of watt meter which becomes actuated in case of excessive power, and which operates the circuit breaker after a certain number of watts of excess power has traversed the same.

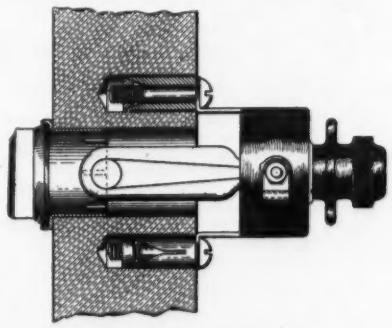
835,416. REGULATOR FOR ELECTRIC CIRCUITS; Edgar W. Gough, Great Barrington, Mass. App. filed July 6, 1905. Provides means whereby the current flow from all the voltage impressed upon an electric circuit by a storage battery or other source can be maintained constant by cutting in one or more of the generating elements. The switch arm is adapted to have an abrupt movement so as to avoid short circuiting the adjacent contacts.

835,419. ALTERNATING CURRENT BLOCK SIGNAL SYSTEM; Max R. Hanna, Schenectady, N. Y. App. filed Apr. 26, 1906. The block sections are energized by an alternating current and the signals are operated by secondary circuits therefrom through polyphase relays which are actuated by separate currents from different block sections.

835,427. RECEPTACLE; Charles H. Hill, Schenectady, N. Y. App. filed Feb. 11, 1905. Relates to a special form of receptacle for the back of switchboards to contain indicating lamps which show the condition of the bus bars.

835,441. SIGNALING SYSTEM; Wesley E. Laird, Pittsfield, Mass. App. filed July 22, 1904. A selective signaling system adapted to enable any station to be called without disturbing the other stations. Has step-by-step device worked by an intermittent current.

835,444. INDUCTION-MOTOR CONTROL; Marius C. A. Latour, Paris, France. App. filed Mar. 27, 1905. The method of controlling an



835,427.—Receptacle.

induction-motor to obtain speeds intermediate the speeds corresponding to two different numbers of poles, which consists in varying the distance between poles without varying their number.

835,461. ELECTRICAL MEASURING INSTRUMENT; Edwin F. Northrup, Philadelphia, Pa. App. filed May 26, 1906. Instrument for measuring by direct duplication the ratio of an unknown to a known resistance. A form of bridge having a special construction of indicator in the cross connection.

835,484. DEMAND INDICATOR; Leonard Wilson, Pittsfield, Mass. App. filed Sept. 18, 1905. A maximum demand indicator of the "Wright" type in which a heating strip is arranged in proximity to a U-shaped tube which contains an expansible fluid. The present invention is designed to overcome certain defects due to current fluctuations in this type of instrument.

835,487. SYSTEM OF ELECTRICAL REGULATION; John L. Creveling, Cronly, N. C. App. filed Dec. 19, 1903. Provides for charging storage batteries from a generator running at variable speeds so as to maintain a desired constant voltage upon the work circuit. Employs a rheostat with a motor driven arm.